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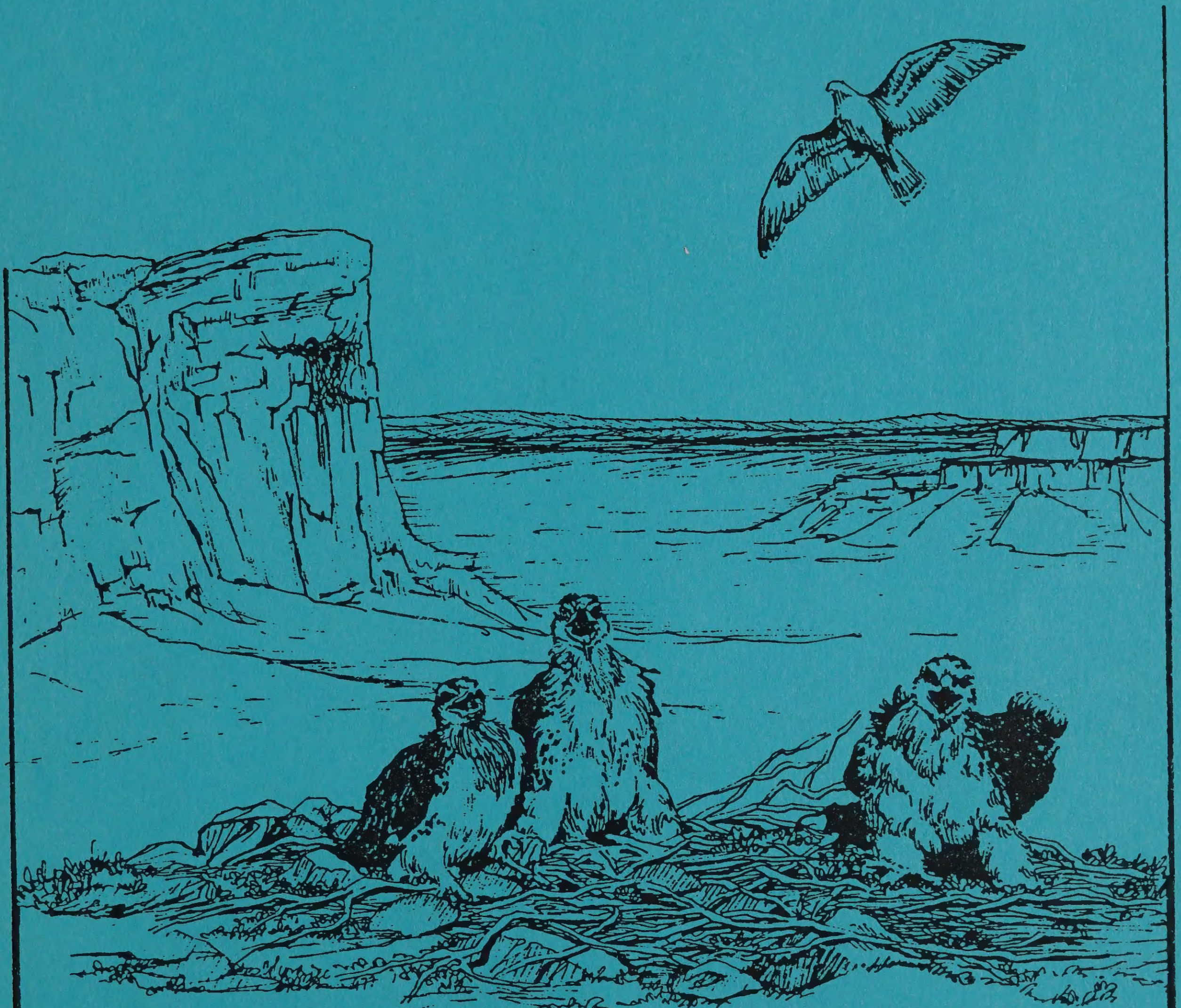
RECOMMENDATIONS FOR RAPTOR MANAGEMENT IN THE CAVE GULCH EXPLORATORY GAS UNIT AREA



PREPARED FOR
HAYDEN - WING ASSOC.
and
ARRETT RESOURCES CORP.

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BY
MAYO W. CALL
AFTON, WYOMING

DECEMBER 1995

BUREAU OF LAND MANAGEMENT
PLATTE RIVER RESOURCE AREA

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RECOMMENDATIONS FOR RAPTOR MANAGEMENT IN THE CAVE GULCH EXPLORATORY GAS UNIT AREA

CASPER BLM DISTRICT
PLATTE RIVER RESOURCE AREA

PREPARED FOR:

HAYDEN-WING ASSOCIATES
LARAMIE, WYOMING
AND
BARRETT RESOURCES CORPORATION
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TOPICS DISCUSSED IN REPORT

IN THE FOLLOWING SEQUENCE:

SUMMARY OF REPORT FINDINGS
INTRODUCTION
OVERVIEW AND GENERAL SITUATION
GENERAL DESCRIPTION OF RAPTOR NESTING HABITAT IN CAVE GULCH AREA
POPULATION STATUS AND TRENDS OF GOLDEN EAGLES AND FERRUGINOUS HAWKS
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PLATE IV FERRUGINOUS HAWK AND GOLDEN EAGLE NESTS ON STORAGE TANKS IN THE RAWLINS BLM DISTRICT.
PLATE V PHOTOS SHOWING THE PRIMARY PREY SPECIES OF THE FERRUGINOUS HAWK AND THE GOLDEN EAGLE.

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SUMMARY OF REPORT FINDINGS

The following is a summary of my findings and recommendations for raptor management in the Cave Gulch Exploratory Gas Unit Area, as discussed in more detail in the report.

1. Both golden eagles and ferruginous hawks have nested in the Cave Gulch Area during past years, but there is no documented production in recent years. Both species were observed perched on certain nests in 1995, but neither species laid any eggs.

2. Current natural gas drilling in the area has already made some of the area undesirable for nesting by sensitive species of raptors, and proposed drilling and production plans will make most of the area unsuitable for nesting. However, a few very tolerant individual birds may still succeed in nesting there.

3. The preferred raptor prey species, rabbits and ground squirrels, are reported to be at relatively low levels. Eagles and ferruginous hawks may not nest until prey populations increase in this area, with or without increased drilling operations. We cannot say that we will lose raptor production in the next few years with the proposed drilling because we are not sure the birds will nest anyway until their preferred prey increases.

4. Both golden eagle and ferruginous hawk populations are reported to be doing well throughout most of the West. Wyoming reported the highest number of nesting pairs of both golden eagles and ferruginous hawks of any of the nine western states in a 1987 survey.

5. There are from 10,000 to 15,000 ferruginous hawks range-wide (western United States and Canada) and about 100,000 golden eagles in North America. The golden eagle is world-wide in distribution in the northern hemispheres.

6. Birds of prey were shot, trapped, and poisoned with impunity by the tens of thousands until the early 1960's. Forty thousand bald eagles were killed for a bounty in Alaska alone between 1917 and 1927. The Bald Eagle Protection Act of 1940 placed this species under protection in the lower 48 states, but the golden eagle was not given legal protection until an Amendment to this Act was passed in 1962. Until then, golden eagles were shot and poisoned indiscriminately by sheepmen and "sport" shooters. Hawks were provided legal protection by the Migratory Bird Treaty Act, along with all song and insectivorous birds, but it was largely ignored. One Wyoming Game and Fish District Supervisor told me that he had personally shot at least 40 golden eagles in one year, because the eagles killed important game species. Most states have now passed laws for protecting all birds of prey.

When?

CS

7. The general public now has a much greater interest in birds of prey and have exerted the necessary pressure on the U. S. Congress to give them legal protection. However, there is no justification for now saying that a pair of eagles or ferruginous hawks is worth millions of dollars when a few years ago we were shooting them by the thousands *for fun.*

8. A wide variety of people use the public lands --- from recreationists to livestockmen, to oil and gas people, to wildlife photographers. All kinds of users of the public lands may cause problems for nesting raptors, sometimes causing nest abandonment simply by being there. Some people still shoot hawks. All these people cause some nest losses but are almost never observed so are not prosecuted. We have been able to "manage" raptor populations and maintain "reasonable" numbers in the face of these losses, in addition to natural mortality, which in itself is sometimes very high. Therefore, I think it is only reasonable to provide for the prudent and timely removal of underground resources, such as oil and gas by the companies that legally own these resources, even if it means the "taking" of an occasion nest. And, in many cases no birds are destroyed; they are merely forced to nest in other areas for some period of time.

9. Public lands can be managed under either "multiple use" or "single use" concepts. Most areas can be managed for several simultaneous uses. Other areas may be managed for the single best use, especially in small areas where one single resource may have extremely high values. I think the Cave Gulch Area should be given priority as a natural gas field, while at the same time providing for the needs of the eagles and hawks for nesting by providing artificial nest structures. where?

10. Considerations in raptor management are discussed, including individual species sensitivity to human disturbances, importance of suitable nesting substrates, importance of the prey base, status and trend of raptors in question, and possibilities for mitigation in development projects.

11. The relative values between raptors and natural gas in the Cave Gulch Unit are discussed. Based on estimated populations of eagles and ferruginous hawks in Wyoming, there is no justification for stopping, or unduly delaying, natural gas production in this Unit because of "possible" future nesting by one pair of golden eagles and two pairs of ferruginous hawks. The estimated value of just two or three of the proposed gas wells could well be millions of dollars per year.

12. My recommendations for this Unit are discussed, i.e.: permitting unrestricted gas drilling and production with certain stipulations, including funding a surveying and monitoring program and constructing a number of artificial nesting structures for the birds to use as alternate nesting sites. elsewhere?

INTRODUCTION

Barrett Resources Corporation (Barrett) of Denver, Colorado has been working with the Casper District of the U. S. Bureau of Land Management (BLM) in preparing plans to drill and develop natural gas wells in the Cave Gulch Exploratory Gas Unit Area (Unit Area) of southcentral Wyoming.

Various consulting firms and/or individuals have been working with the BLM in preparing an environmental assessment of potential impacts, either beneficial or adverse, of the proposed project.

Hayden-Wing Associates, environmental consultants, asked me to review the proposals for raptor monitoring and management in the project area, to include their recommendations for construction and placement of artificial nest structures (ANS) as alternate nesting sites for ferruginous hawks (Buteo regalis) and golden eagles (Aquila chrysaetos). The Barrett Resources Corporation Cave Gulch Natural Gas Development Project Environmental Assessment and Selection of Artificial Nest Structure Locations for Raptor Nest Mitigation documents were reviewed, and I went into the project area with Larry Hayden-Wing and Jeff Winstead on 10 October 1995 to examine raptor habitat and nest locations on the ground.

Following my field examination, I attended a meeting called by the Platte River Resource Area Manager, Gary Johnson, on 24 October 1995 to discuss my views on raptor management in this area with other members of his staff and with personnel from the U. S. Fish and Wildlife Service, BLM State Office, Barrett Resources Corp., and Chevron U.S.A., Inc. This report presents my views, as presented in that meeting.

RAPTOR MANAGEMENT IN THE CAVE GULCH AREA

OVERVIEW AND GENERAL SITUATION

Barrett Resources Corporation (Barrett) of Denver, Colorado has already drilled several gas wells in the Cave Gulch Area. Test results have indicated a substantial shallow gas reserve and Barrett seeks approval to develop these reserves from their leases through implementation of the proposed Cave Gulch natural gas development plan.

The Chevron, Moncrief, Coastal, and Prima oil and/or gas Companies have also drilled numerous gas wells in the Cave Gulch Area. It is likely that these companies will desire to drill additional gas wells. Barrett, by itself, can legally drill 16 wells per section (one for each 40 A.) on its leases, providing there are no serious conflicts with other important resources.

Figure 1 in the document entitled Selection of Artificial Nest Structure Locations for raptor nest mitigation-- North Cave Gulch Area vividly portrays existing and proposed gas wells in relation to existing raptor nests in this area. Visiting the area provided an immediate impression of how much disturbance this gas field development must be causing raptors that attempt to nest here and how much more disturbance would occur with the planned development. Pump houses and storage tanks were obvious throughout the area, and a drill rig was seen protruding above the eroding ridges.

Old ferruginous hawk (Buteo regalis) and golden eagle (Aquila chrysaetos) nests are scattered throughout the area. Upon examination, it is obvious that many of the ferruginous hawk nests are very old. These birds have been nesting here for decades, probably longer. There are a few areas from one-quarter to one-half mile in diameter that are still relatively undisturbed, but not many. If approved as proposed in the development plan, there would soon be many more gas production facilities, roads, and pipelines scattered around the area.

One of the problems in trying to assess the potential impacts on raptors from the proposed development plan is that there appears to be no precise number of wells under consideration. I was informed that additional wells and/or changes in proposed locations are continually under consideration. Also, if this proposed plan is approved by the Resource Area Office (AO), with some modifications, there is nothing to prevent the operator at their discretion from introducing proposals for new well sites until the legal limit of 16 per section is reached. Such new wells could largely negate on-site efforts to mitigate disturbances to active pairs of raptors nesting in the area.

GENERAL DESCRIPTION OF RAPTOR NESTING HABITAT IN THE CAVE GULCH AREA

This area, extending southwesterly from the western end of Cave Gulch, is a relatively small area of eroded draws and protruding near-vertical rock strata within a much larger grassland area. Nesting raptors are attracted to it because of the numerous rocky outcroppings, low cliffs, and rocky pinnacles and boulders that provide nesting substrates with some degree of security from terrestrial predators. Golden eagles prefer to nest on the higher cliff faces, but ferruginous hawks will nest almost anywhere from the ground up. However, most of the ferruginous hawk nests are on rocky ledges or pinnacles. Figs. 1 through 8 show some of the topography, nest sites, and gas wells in the area.

Even though the area contains numerous old ferruginous hawk nests and at least three golden eagle nests, neither of these species had an active nest in this area in 1995 ("active" defined as a pair that produces at least one egg). Nor has there been documentation of any active nests in the area in recent years. A helicopter survey to map existing nests was made in the fall of 1994. Observations to determine locations of active nests, if any, were started in the spring of 1995. Ferruginous hawks were observed perching on two or three of the nests, with an adult seen in a laying/incubating position on one of the nests. However, no eggs or young were produced by either of the two pairs of hawks whose primary nest seemed to be # 26 for the southerly pair and nest # 3 for the northerly pair. The two territories they utilized most are shown in Figure 1 of the document, Selection of Artificial Nest Structure Locations for Raptor Nest Mitigation --North Cave Gulch Area, prepared by Hayden-Wing Associates.

Golden eagles were observed perched on nests # 2 and # 20 at various times in the spring of 1995. There was no evidence of eggs having been laid.

It is not known why neither the hawks nor eagles produced any eggs in 1995, but it may be that both species instinctively sensed that their respective preferred prey species were not sufficiently abundant for raising nestlings. Ground squirrels (Spermophilus elegans) are the preferred prey for ferruginous hawks, normally making up at least 80% to 90% of their food, and rabbits, either white-tailed jackrabbits (Lepus townsendii) or cottontails (Sylvilagus auduboni) are the primary prey for golden eagles (Plate V). Both lagomorphs and rodents are reported to be relatively scarce in this area. Rabbits and ground squirrels are known to be scarce in other parts of southern Wyoming. In one of those areas of low prey numbers, five pairs of golden eagles have not produced any young for the past three years, and ferruginous hawk production is the lowest of the past eight years (Call 1995). If, or when, these prey species become more numerous in the Cave Gulch area, the raptors will likely again become productive.

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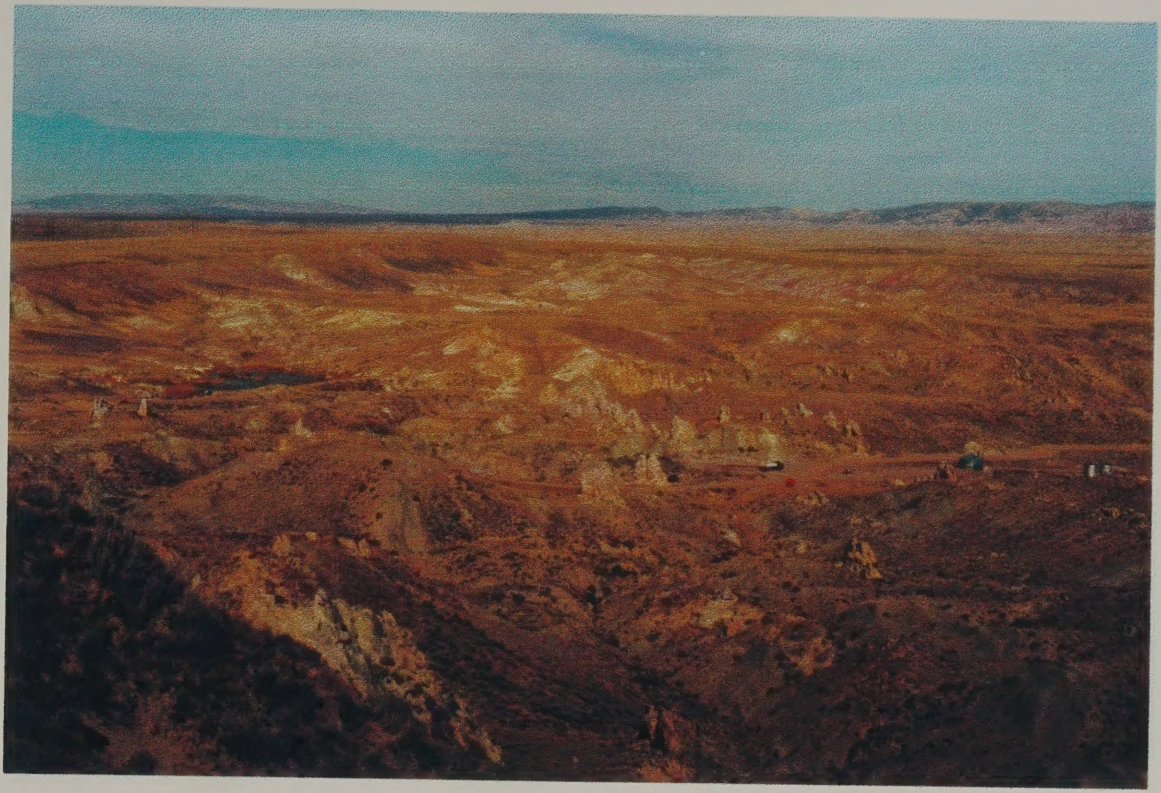


Fig. 1. Chevron producing well No. 1 in right center of photo and rocky outcropping in center of photo where GE nest no. 20 is located on backside of cliff.

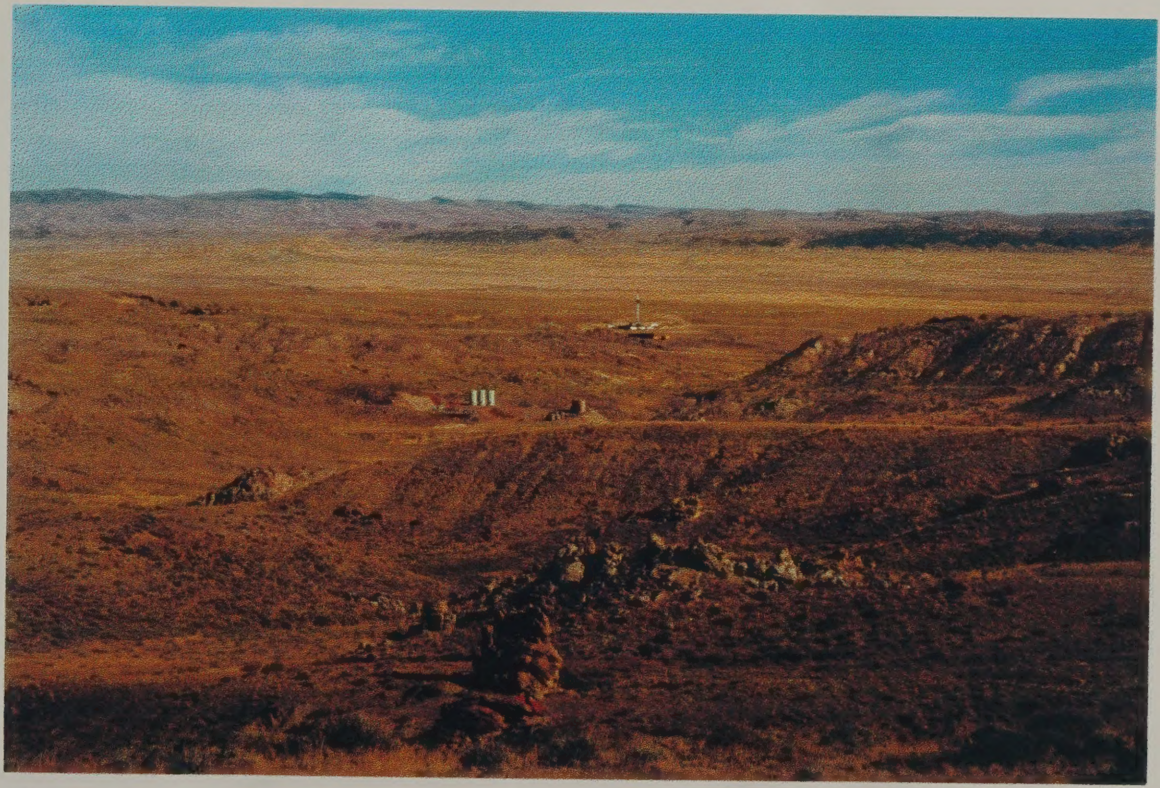


Fig. 2. Chevron producing well No. 16 near center of photo and CGU No. 6 in background.

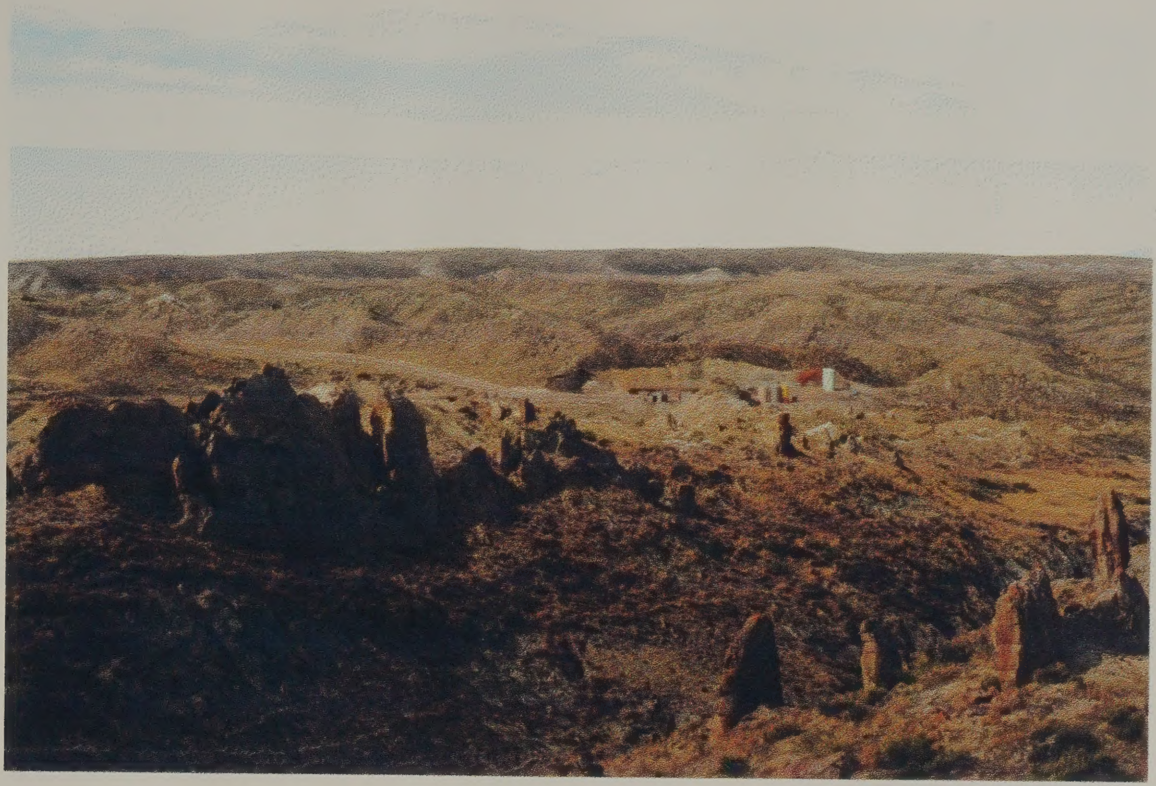


Fig. 3. Golden eagle nest no. 2 is on the cliffs on left side of photo and Chevron producing well No. 16 is in the right background of photo.

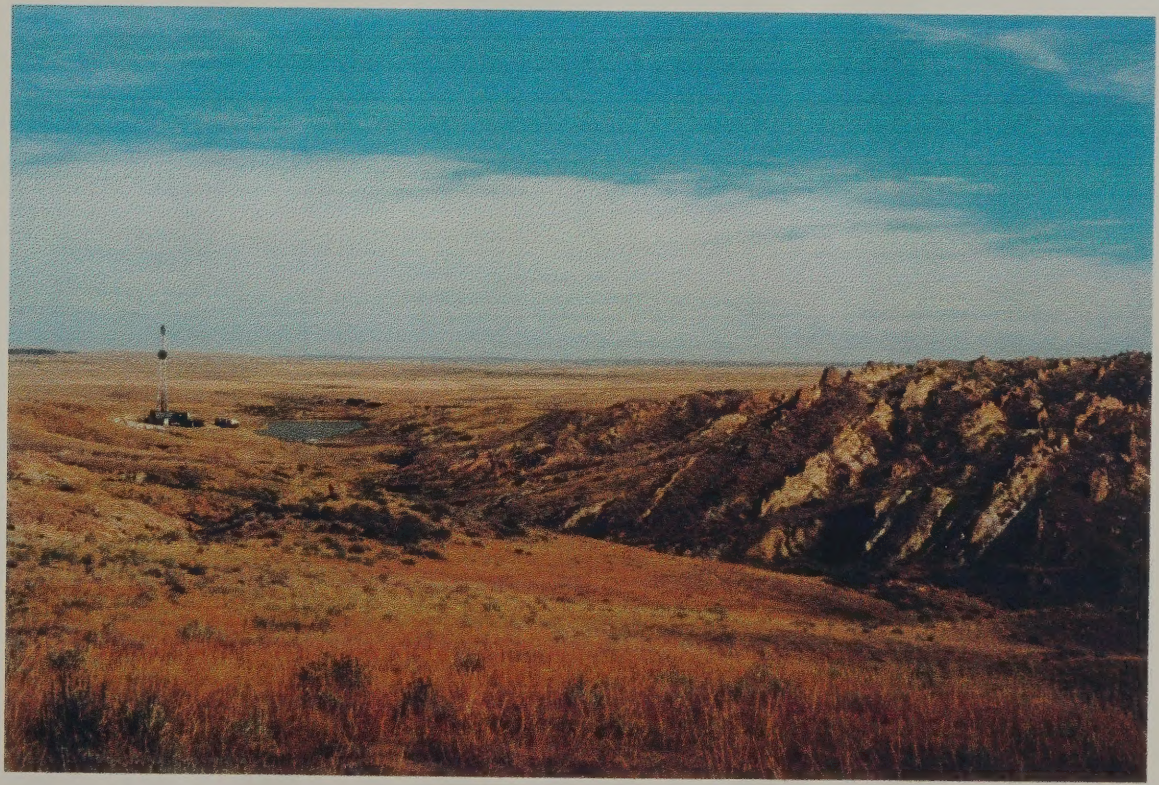


Fig. 4. CGU drill rig is on left side of photo and FH nest no. 4 is on a rock pinnacle near skyline to right of center of photo.

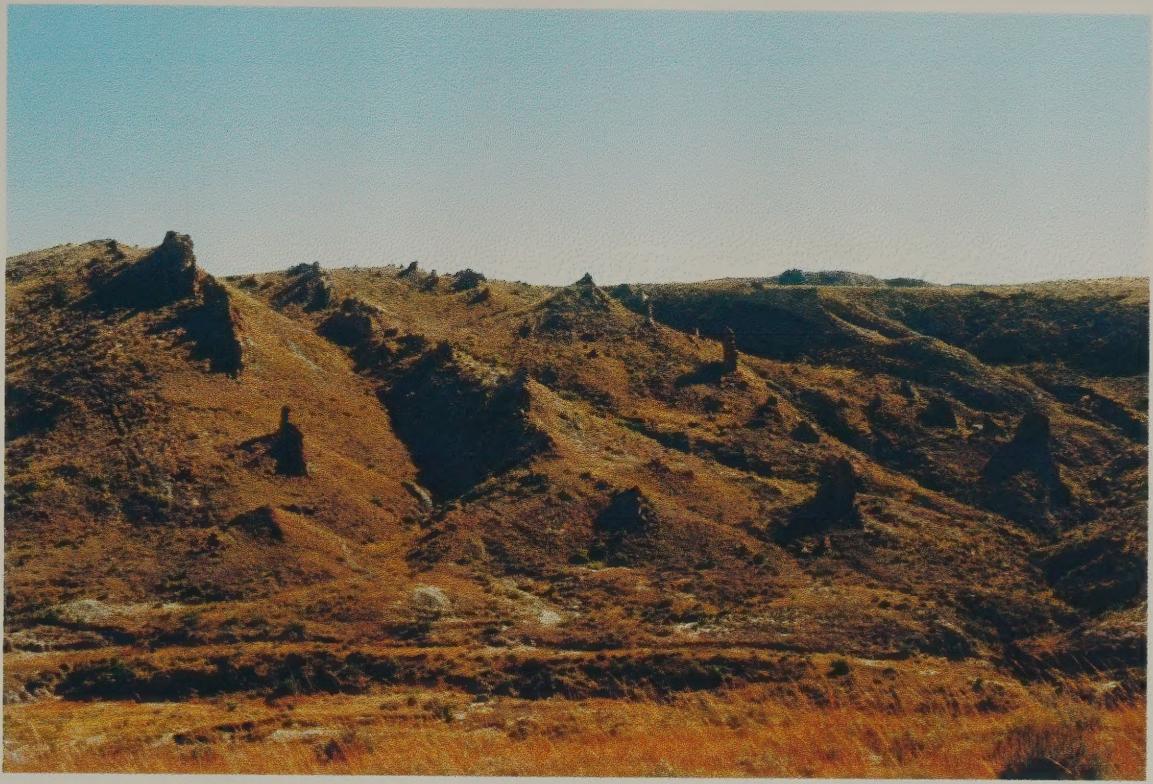


Fig. 5. FH nest No. 3 is on the tall pinnacle which is the second pinnacle from the right side of the photo and near the bottom of the draw.

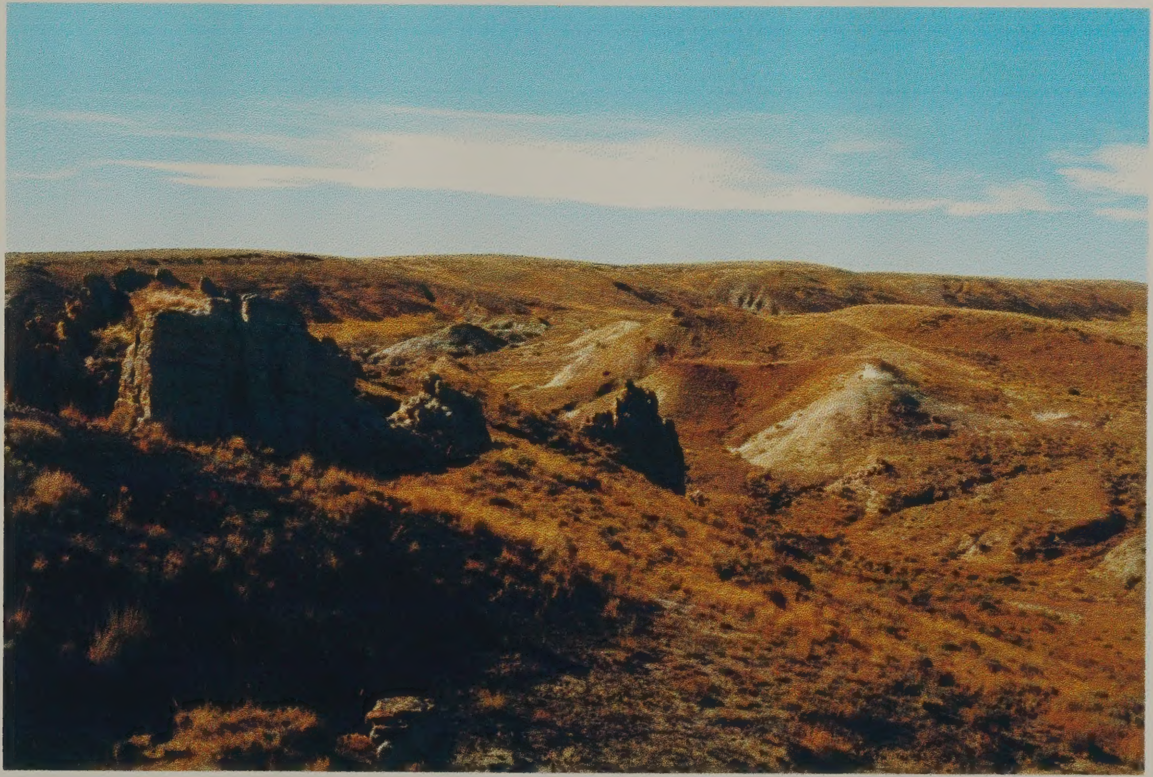


Fig. 6. This photo is a view, looking towards the west, of the upper end of the draw in which ANS no. 8 is proposed. This area is still reasonably free of disturbance.

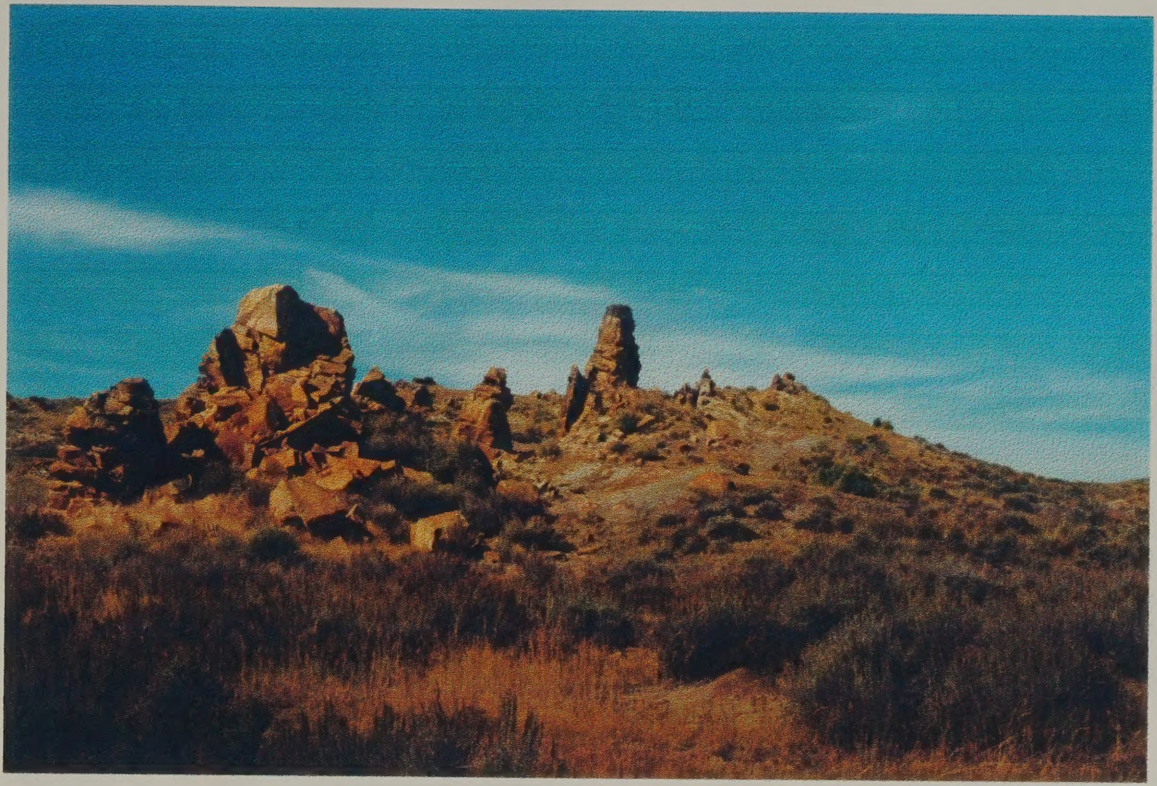


Fig. 7. FH nest no. 15 is on the rocky pinnacle in the center of the photo. Adult hawks were observed perched on this nest in the spring of 1995.

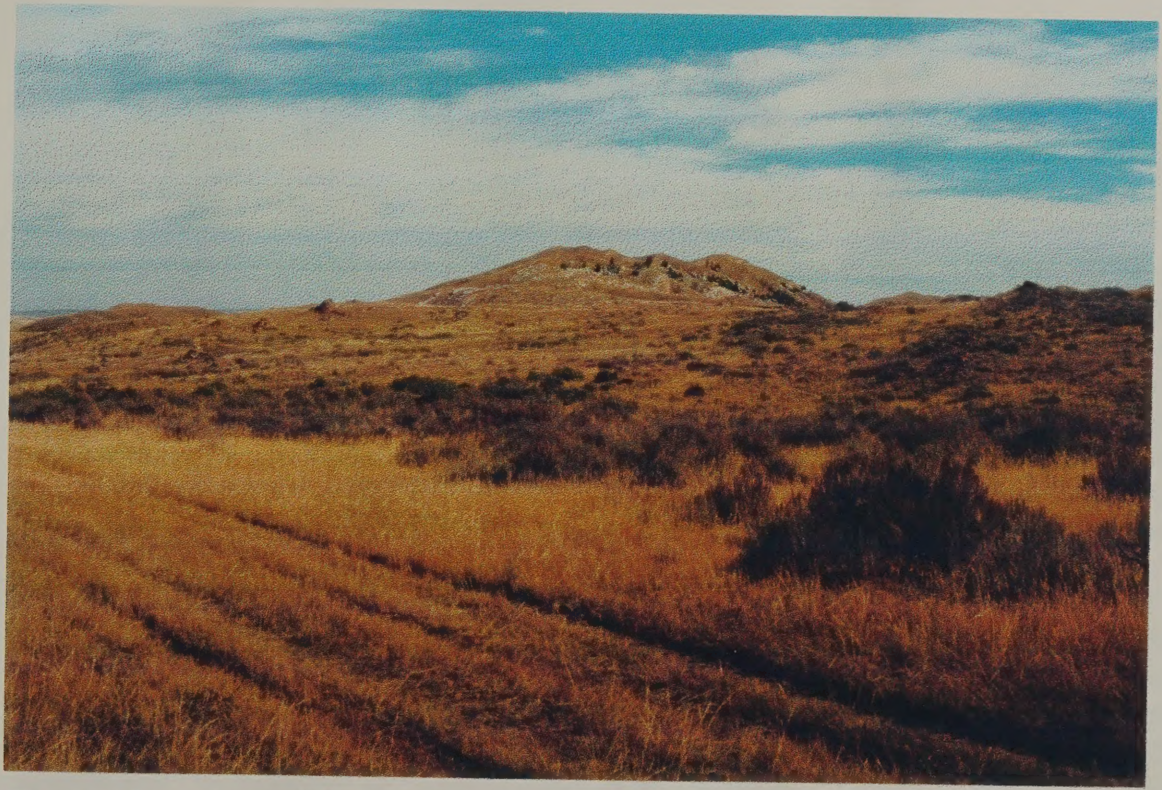


Fig. 8. View of area lying easterly from FH 15 where an ANS would make a good alternate nest site for birds using FH 15.

If there are found to be parts of the Cave Gulch Area that produce relatively high populations of prey, they should be protected, if practical, from non-essential surface disturbance. Roads and pipelines might be planned to avoid such areas. Suitable nesting sites for raptors are very important, but good hunting areas are also critical to good productivity.

In view of the great amount of both existing and planned human activity and surface disturbance in the Cave Gulch area, it is very unlikely it will be of much importance as a raptor production area in the forseeable future. Never-the-less, an effort should be made to encourage nesting in the area by the more tolerant raptors that remain in the area. This may be done by: (1) avoiding unnecessary visitations and distubances by company personnel to those areas not planned for drilling or facility installations during the current nesting season, and (2) installing a few artificial nesting structures (ANS) within the project area for both ferruginous hawks and golden eagles in some of the least disturbed areas. As stated later in this report, the primary method recommended for mitigating for lost raptor nesting habitat is to construct a number of artificial nesting structures in suitable off-site areas.

As stated in the Project-Wide Objectives on page E-3 of the environmental assessment, we should try to take care of the birds' needs while still providing for the prudent, reasonable, and timely development of the oil and gas resource.

POPULATION STATUS AND TRENDS OF GOLDEN EAGLES AND FERRUGINOUS HAWKS

Over the years, both golden eagles and ferruginous hawks have been species of special concern by State and Federal wildlife agencies. Both species were under the umbrella protection of the Migratory Bird Treaty Act (Canada, 1916; Mexico 1936), but both species were wantonly shot by sheepmen and “sport” shooters with complete disregard for their legal protection under that Act. In fact, in 1959 one District Supervisor for the Wyoming Game and Fish Department told me that he had personally shot at least 40 golden eagles in the past year! His reason was that eagles killed grouse, ducks, and pheasants that were important to the Department. Hundreds of golden eagles were also killed by electrocution when attempting landings on the crossarms of high tension power line poles. With the cooperation of power companies, this problem has been greatly lessened.

With the passage by Congress in 1962 of an Amendment to the Bald Eagle Protection Act (16 U.S.C. 663a) the golden eagle is now provided essentially the same protection as the bald eagle (Haliaeetus leucocephalus), except where the bald eagle is listed as either “threatened” or “endangered”. The golden eagle is not considered “ threatened” or “ endangered” in any State or Province in North America.

When considering the potential impacts on nesting and production of golden eagles and/or ferruginous hawks from resource development projects, we should also consider total range or distribution of the species. Golden eagles are almost world-wide in distribution; ferruginous hawks are found only in the western United States and Canada.

GOLDEN EAGLE

Golden Eagles have been reported as "doing well" throughout the West during the past ten years (C. White, Brigham Young Univ., pers. commun.; M. Kochert, BLM, Snake River Birds of Prey Area, Boise, ID, pers. commun.). The most recent published data I could find on the status and trend of golden eagles is a report presented to the Western Raptor Management Symposium and Workshop by Harlow and Bloom (l989). The following table is copied from that report.

Table 6. Status and trends in golden eagle populations in nine western states

State	Occurrence	Status	Trend	Statewide Est. Nesting Pr.	Total no. Known Territories--1977-86
California	C	SP	D	500	--
Oregon	C	--	--	--	506
Washington	C	SP	--	--	190
Idaho	C	--	--	--	156
Utah	C	--	I	--	--
Nevada	C	--	S	1,200	430
Wyoming	C	--	I	3,381	804
Montana	C	SP	I	--	50
Colorado	C	--	S	500-600	500

Based on information provided to the National Wildlife Federation by state wildlife agencies in 1987.
C = common
SP = species of special concern
-- = information not available
D = declining; I = increasing; S = stable

In their report, Harlow and Bloom (l989) stated that " Golden eagles were considered common by all state respondents with the exception of California where they are relatively uncommon as a breeding species (Table 6)". The golden eagle is listed as a species of special concern by the states of Washington and Montana, and is "Fully Protected" by California. This report cites Olendorff et al.(1981) as estimating a wintering population of 49,515 golden eagles for the nine states covered in this report and Braun et al. (1975) as estimating a total population of 100,000 golden eagles for all of North America. The report indicates that five of the nine western states have either stable or increasing populations, with three states not having

sufficient information for a determination, and one state (California) with a declining population.

Being world-wide in distribution, the total number of golden eagles would far exceed the estimate of 100,000 birds for North America. The Wyoming estimate of 3,381 nesting pairs and 804 known nesting territories was the highest of any state reporting. The reliability of these reports is open to conjecture, but they at least indicate that Wyoming and most other western states had either stable or increasing populations as recently as eight years ago. My observations indicate that golden eagle numbers increase slightly when rabbit populations are high and decrease slightly when rabbit numbers decrease. This predator-prey relationship occurs for most raptors, with variations depending on the number of prey species available to the raptors during the nesting season. Golden eagles do not nest if they sense that the available prey is inadequate for raising a brood.

FERRUGINOUS HAWK

The ferruginous hawk nests only in the western United States and Canada. Because of reported declines in their population, a petition was presented to the U. S. Fish and Wildlife Service in June, 1991 to list the ferruginous hawk as an endangered species. The petition indicated that the survival of the species was threatened by a long-term population decline, human disturbance, and past and present habitat destruction and modification.

In response to the petition, the U. S Fish and Wildlife service intensified their review of the status of the ferruginous hawk (Fish and Wildlife Service 1992). The wildlife agencies of all western states and Canadian provinces were queried on estimated numbers of nesting pairs of ferruginous hawks within their jurisdictions, and these figures were compared with an estimate of minimum numbers of nesting pairs reported by Call (1979). The Services' figures indicated a total nesting population of approximately 5,220 to 6,004 pairs in 1992, compared to Call's estimate of a "minimum" number of nesting pairs of 2,810 to 3,590 pairs in 1979. The Service concluded there was a probable increase of approximately 2,400 pairs in the previous 13 years. While this is probably an erroneous figure because of the improper use of Call's figures, i.e. a "minimum" number of nesting pairs, it is still apparent that the total population of ferruginous hawks throughout its range is only 10,000 to 15,000 birds. There are reports of local declines in nesting populations of the hawks from several states, so it is apparent that additional surveys need to be conducted before an accurate evaluation can be made of the bird's status.

In any case, the Service concluded that, "the petition presented information insufficient to conclude that the requested action may be warranted." In their summary they stated that information "indicates that the ferruginous hawk is highly variable in its annual population levels" and that "the species is currently adapting

positively to various management techniques designed to enhance its population, not least of which is the establishment of artificial nest structures".

CONSIDERATIONS IN PUBLIC LAND RESOURCE USES AND/OR DEVELOPMENT

Managers of public lands are charged with the responsibility of managing lands under their jurisdiction for a variety of uses. Resource specialists determine what interests and resources are present, and the managers then develop plans with their staffs' assistance for the integrated use of these resources. This is a difficult task, because conflicting interests always apply pressure to try to get managers to give priority to their special concerns.

MULTIPLE USE CONCEPT

BLM managers try to manage lands under a "multiple use" concept. This implies an integration of several different resource uses on the same area. For example, livestock grazing, wildlife propagation, and recreational uses can usually be accommodated on the same general area. If serious competition for forage exists between livestock and big game animals, then numbers of each class of animal have to be adjusted to the carrying capacity of the range for the species involved. There is usually a difference of opinion between the wildlife managers and the livestock operators as to which animals should be given priority. Recreation planners dislike livestock using highly scenic areas or desirable camping areas, and the livestock may sometimes need to be excluded.

We have found that antelope can be managed and propagated with few apparent problems in areas of oil and gas development, so long as suitable forage and water remain available to them.

Timber can be harvested from forested areas with beneficial effects for deer and elk if harvesting occurs in a patchwork design such that adequate cover remains without excessive distance between the remaining patches of timber. Planting the openings to desirable forbs and shrubs normally provides considerably more forage for many species of animals than was present in the solid timber stands. Needs of many animal and bird species can often be accommodated through proper planning. Livestock also find better forage in the openings.

SPECIAL OR SINGLE USE CONCEPT

The "single use" concept sometimes needs to be applied in areas where one use of the land is incompatible with other uses. Open pit coal mines generally cannot accommodate public use of the land, partly because of the public safety issue, and

partly because of the need for security for the mining company. Public use of such areas has to be discouraged or prohibited.

Sometimes competing uses cannot be accommodated on the same area. Recreational use is generally not compatible with an open pit coal mine. Animal and bird species that require old growth forests as habitat generally cannot survive in monotypes of new forest growth. Wilderness species often are not compatible with human disturbances and occupation of their habitat. Some raptor species, such as ferruginous hawks, will not nest in close proximity to human activities. They require open areas with minimal human disturbance and will often abandon their nests rather than suffer the stress of human disturbances. Other raptors, such as red-tailed hawks (Buteo jamaicensis) and Swainson's hawks (Buteo swainsoni) are very tolerant of human activities and will nest in close proximity to dwellings, industrial plants, and land development activities.

In general, small animal and bird species are sacrificed in large timber sales, especially where clear-cutting is conducted. However, if a very rare animal or bird species requires a particular geographic area of forest or other vegetation type for their survival, that area may be set aside from all other uses. The Snake River Birds of Prey Area in Idaho, believed to have the highest density of nesting raptors in the world, was set aside by BLM as a special use area for raptors. Rock climbing or other uses of cliffs where peregrine falcons have an active nest are usually prohibited during the nesting season.

Special uses may apply on a seasonal or year around basis. Livestock grazing may be disallowed along riparian zones, either by fencing or management, during spring and summer when these areas are critical for grouse brooding areas or other wildlife uses. Highly scenic areas may be set aside for camping and recreational uses on a permanent basis. Streams and springs may be set aside from public uses because of their importance as municipal water sources.

In general, public lands that contain valuable resources of any type may be set aside as special use areas for that particular resource. Other uses may be accommodated only insofar as they do not prevent utilization of the primary resource.

PROFESSIONALISM AND PRACTICALITY

Wildlife biologists always like to have wildlife given "top priority" in resource management planning. However, we all need to have respect for other resources and uses of the land. It is unrealistic to think we can protect all wildlife in the face of so many competing uses of public lands and resources. The degree of defense of wildlife must be based on the relative importance of the individual species in the area of concern and their status in the state, region, or total range. We must be able to justify wildlife protection recommendations based on the probable adverse impact

on a species from some other land use. We cannot expect a protection recommendation to be given priority by a land manager over another resource use or development if the wildlife species concerned is being maintained in reasonable or “stable” numbers throughout its range, and the competing resource has exceptionally high value. Wildlife biologists have lost some of their credibility over the years because of their lack of flexibility in allowing some losses of wildlife in local areas, especially where proven mitigation methods can be applied that will permit the maintenance of those species in the general area. Also, some uses and/or development of resources cause only temporary losses of habitat and the use of the area by wildlife.

PROBLEMS CREATED FOR NESTING RAPTORS BY VARIOUS PUBLIC LAND USES

A wide variety of authorized uses of the public lands may disrupt nesting activities of birds of prey. These include livestock management activities, varmint hunting, arrowhead hunting, rock climbing, wildlife photography, oil and gas drilling and production, coal mining operations, hard rock mining, wind-powered electrical generation facilities, and a variety of recreational uses. Illegal shooting of raptors is not uncommon, and poisoning of raptors has been a problem in some areas. Poisoning of eagles in Jackson Canyon near Casper several years ago is just one example.

Users of the public lands usually don't realize the problem they cause when they conduct their activities near the nests of some of the more sensitive species of raptors. Even minor disturbances near nests when ferruginous hawks are in the egg-laying or incubating phase may cause the birds to abandon their nests. In my experience, few recreationists realize the potential problem they may cause to birds of prey during the nesting season, and few of the personnel involved in coal mining or oil and gas drilling are aware of this problem until advised by Federal or State land managers.

LEGAL PROTECTION FOR BIRDS OF PREY

Many people cause inadvertent, or unknowing, abandonment of golden eagle and ferruginous hawk nests while simply enjoying or working on public lands. This action can be a violation of both the Migratory Bird Treaty Act (16 U. S. C. 703-712) and the Bald Eagle Protection Act (16 U.S.C. 663a) in the case of eagles, or a violation of the Migratory Bird Treat Act and possibly state laws in the case of the ferruginous hawk. Most, if not all, states regulate the “ take” and provide complete protection to all birds of prey. While numerous such violations probably occur in Wyoming BLM Districts every year, nearly all go unnoticed, and only flagrant violators are ever

prosecuted. Even though precautions are normally taken, wildlife biologists may also cause nest abandonments during normal surveying and monitoring activities.

It seems ironic that companies involved in the extraction of the earth's underground resources, such as oil, gas, phosphate, uranium, etc., and that work under the close supervision of Federal and State agencies, are the most closely regulated and scrutinized users of the public lands. They may be highly criticized, and even more tightly restricted, if they inadvertently cause nest abandonments such as those that are occurring from occasional visitations by other users of public lands who suffer no penalties. True, some developers show complete disregard for wildlife after they obtain the necessary permits, but most are responsible and recognize that their operations may be shut down if they disregard the permit stipulations.

The Bald Eagle Protection Act, the Endangered Species Act, and the Migratory Bird Treaty Act are the primary laws providing protection to birds of prey. Each of these laws contains provisions for the "taking" of nests or birds under special circumstances. If the agencies and the company involved recognize a need to cover a raptor nest to prevent nesting too close to approved development operations, or if an active nest is discovered after commencement of mining or drilling activities, a special permit may be obtained from the U. S. Fish and Wildlife Service to foster eggs or young out to other nests in the area, to cover the nest, or take other actions as deemed appropriate by the management agencies.

Even though the birds and their nests are provided protection under the law, it is often prudent for agencies to permit covering or removal of nests near planned activities and to prescribe mitigation measures, such as artificial nesting structures, that will provide alternate nesting opportunities for the displaced birds. In regions where artificial nest structures have been highly successful, and where raptor production and survival can be expected to exceed that from natural nest sites, there is no good reason why this mitigation method should not be used. In the case of natural gas drilling operations, birds may sometimes return to their natural nest sites during the production phase when human disturbances are much reduced. This will partly depend on the individual sensitivity of the birds that have been using the area (Plate IV). The time period between drilling and production may only involve a few years during which time the birds' needs are taken care of by nest structures and the gas company is provided the opportunity to extract the gas resource.

GENERAL CONSIDERATIONS IN RAPTOR MANAGEMENT

There are many factors to be considered in the management of any raptor population. These include: (l) species sensitivity to, or tolerance of, human disturbance, (2) availability of nesting substrates, (3) populations and availability of suitable prey species, (4) population numbers and trends of the raptors concerned, on a state-wide and range-wide basis, and (5) species status, i.e., threatened, endangered, sensitive, state-listed, etc.

Some species of raptors, such as ferruginous hawks, are very sensitive to human disturbances and presence, and others, such as red-tailed hawks, are not. Biologists need to have a good understanding of species behavior before they prepare management recommendations. Even though all hawks are given the same theoretical protection under the Migratory Bird Treaty Act, or even under special state non-game laws, some species will need much more attention than others.

Different species of hawks nest on different kinds of substrates. For example, red-tailed hawks commonly nest on high, sheer, cliff faces;, in many kinds of trees and shrubs; on power poles and various other man-made structures. I have never seen documentation of a red-tailed hawk nesting on the open ground. For some reason, ferruginous hawks very rarely nest on high, sheer, cliff faces, but do nest on all types of boulders, pinnacles, and low, rocky outcroppings, and they *commonly* nest directly on the ground in Wyoming. Ground nests suffer high losses from terrestrial predators. Swainson's hawks nest *almost* exclusively in trees or shrubs, or on man-made structures. In 40+ years of raptor observations and study, I have only seen documentation of three Swainson's hawk nests on the ground. One of these was a nest that fell out of a small bush and the young were raised on the ground; another was a nest that fell out of a dead tree and the pair re-nested on a steep, rocky hillside nearby. The third was on an elevated rock pile in Canada.

These are just a few examples to show that biologists need to know where raptors can be expected to nest in their areas of responsibility. If there are no trees, bushes, or man-made structures in the area, you can forget about Swainson's hawks. If there are no trees, bushes, rocky bluffs or cliffs, or man-made structures in the area, you need be concerned only with ferruginous hawks (of the three mentioned; northern harriers nest *exclusively* on the ground). Power poles are the most common man-made structure utilized for nesting by many species of raptors.

We have demonstrated that artificial nest structures have been highly acceptable to ferruginous hawks for nesting in southern and south-central Wyoming. Where natural nesting substrates are not available, nesting structures will often provide hawks the opportunity to use vast areas of desert or prairie where they might otherwise not nest.

Raptors cannot nest in areas where there is inadequate, available prey to raise their young. There is a limit to how far birds will fly to obtain prey. Different raptor species key in on different kinds of prey, and some species utilize different kinds of prey in different areas and in different seasons. It depends partly on what prey species are available. The Wyoming ground squirrel is the key food item for ferruginous hawks in Wyoming, and cottontail rabbits and jackrabbits are key prey items for golden eagles. For some unknown reason, ferruginous hawks very rarely take prairie dogs. If certain species of raptors have been nesting for several years

in a particular area, and then fail to nest for a few years, the probable reason is a reduction in the preferred prey species and an inadequate number of buffer species.

Even though all hawks are protected under State and Federal laws, they do not all need the same kind of protection or management to maintain their numbers. Since the total range-wide population of ferruginous hawks is only about 10,000 to 15,000 birds, they should be provided greater consideration in resource management plans than species like Swainson's hawks that number in excess of 250,000. Golden eagles are also estimated to number in excess of 100,000. Since most, if not all, raptor populations fluctuate over time, often corresponding with natural cycles in rodent and rabbit populations which they require for survival, it is probably not practical to try to always maintain raptor numbers on a local basis. If rabbit or squirrel populations "crash", there is *nothing* a biologist can do to sustain the raptor numbers.

We believe that birds of prey may move on to other states or regions for nesting when they instinctively sense that prey is not adequate in a local area where they may have nested for many years. The birds may not be lost to the overall population, but may simply have moved away. Canada has experienced a big increase in number of nesting ferruginous hawks in Alberta and Saskatchewan. The estimated number of nesting pairs increased in Alberta by 700 pairs between 1982 and 1987 (Olendorff 1993). Schmutz (l993) stated that the increase was probably due to an increased population of ground squirrels across a large area and an increased use of *artificial nest structures.*

The species "status" is an important factor in the amount of *real* concern we should exercise over a particular species. Designations of "threatened", "endangered", and "state-listed" have been applied because of serious declines in populations or the relative rarity of the species. These designations automatically signal a legal requirement that those species be given priority in management programs.

IMPORTANCE OF CAVE GULCH AREA TO NESTING RAPTORS

There are several old ferruginous hawk nests and three old golden eagle nests in the broken terrain comprising the Cave Gulch Area. Locations are mapped in the Hayden-Wing Associates report entitled Selection of Artificial Nest Structure Locations for Raptor Nest Mitigation --- North Cave Gulch Area.

Two pairs of ferruginous hawks and one pair of golden eagles were observed by biologists perched on certain nests. However, no eggs or young were produced by any of these birds in 1995.

There is no documentation of any production from any of these nests. There is no question that some of the nests produced young over the years, but possibly

because of lack of funding for surveys, or perhaps because other areas, species, or programs had higher priority, this area was not surveyed for nesting raptors. This indicates to me that there was no special interest in this area for raptors, even though the area is obviously some of the best raptor nesting habitat in the area. Biologists vary in their particular interests in wildlife, and former biologists may not have had a particular interest in birds of prey. If an interest in exploration for gas had not occurred, the area might have remained of little concern in the Platte River Resource Area management programs.

If there were no natural gas drilling and production occurring in the area, one or two pairs of golden eagles or ferruginous hawks *might* nest in the area each year, providing the *available* prey supply was adequate. One possible reason why no birds of prey produced young during 1995 might be that the preferred prey was inadequate for both species. The term "*available*" means that the rodents and rabbits are in a sparse enough, and short enough, vegetation type that the hawks or eagles have a fair chance of catching them.

There is already enough disturbance being caused by on-going gas drilling and production activities that some of the area is already of doubtful suitability for nesting by sensitive species. The planned development of natural gas wells will make most of the area questionable for raptor nesting.

Northern harriers (Circus cyaneus) and American kestrels (Falco sparverius) have both been observed in the area and probably nest there. The harriers normally nest in marshy areas or in grassy draws, and the kestrels nest in cavities in rocky outcroppings or cliffs. Both species are tolerant of human activities.

RELATIVE VALUES BETWEEN COMPETING RESOURCES --- RAPTORS vs. NATURAL GAS

In Alaska, commercial and sport fishermen succeeded in getting the state legislature to pass a law placing a bounty on bald eagles in 1917 by asserting that eagles were causing a diminishing supply of salmon because of their depredations on these fish. The bounty proponents also claimed that eagles were very destructive to young deer and other game animals. For the first six years the amount paid was $ .50 per bird, but in 1923 the price was raised to one dollar. Up to August, 1927, just ten years after the law was passed, the official records show that *more than 40,000 eagles had been killed* for the bounty! The over-exploitation of salmon by commercial fishermen was played down as a reason for the decline in salmon numbers. The Alaska bounty law on eagles was not repealed until 1953.

In the 1940's and 1950's eagles and hawks were shot for sport throughout the West. Sheepmen shot golden eagles on sight because eagles occasionally preyed on young lambs. Hunters, and even wildlife department officials, shot eagles and

hawks because the birds preyed on cottontail rabbits, grouse, pheasants, ducks, and other game species.

During the past three decades there has been a greatly increased interest in birds of prey by the American public. Because of this interest, several Federal and State laws have been passed for their protection, including the Bald Eagle Protection Act (with Amendments), the Endangered Species Act, and the Migratory Bird Treaty Act. These laws were passed because large numbers of people and organizations began asserting the view that birds of prey have real value for esthetic, economic, and ecological reasons.

This simply shows how the whims of the people change over time. In Alaska, people slaughtered our national bird by the thousands for fifty cents apiece. Today, a person can be charged with a misdemeanor for killing a state bird, such as a meadowlark in Wyoming.

Federal and State agencies are charged with protection and maintenance of populations of birds of prey. However, in the real world we should recognize that all birds cannot be protected against all other interests. Bird, and other animal, populations are dynamic and can be "managed", or "manipulated", upward or downward. Our goal in eagle and hawk management, as well as for other wildlife species, should be to maintain "reasonable" numbers throughout their ranges.

We presently have "good" populations of golden eagles and ferruginous hawks throughout most of their historical ranges. As stated previously, numbers of both species fluctuate periodically in local areas for various reasons, but proven management practices can be implemented to increase numbers if serious declines start occurring (insofar as those declines have been caused by man's activities). Even with the increasing encroachment of man and his various developments into the eagles' and hawks' habitats in recent years, populations of both species (especially eagles) may be higher than they were thirty years ago.

Having said the above, I do not believe we can justify stopping, or unduly delaying, natural gas drilling and production in the Cave Gulch Unit. The natural gas production from just two or three gas wells in the proposed "core area" around eagle nest # 2 could approach $20 million dollars per year! It is expected that the one pair of eagles would successfully nest in one of the other two alternate nest sites, or on an artificial nest structure, if other conditions were favorable. There was no successful nesting by either ferruginous hawks or golden eagles in the Cave Gulch Unit in 1995 and probably will be none until the prey populations increase. I was told that a dead golden eagle was found alongside the highway west of the unit in October and may well have been one of the eagles observed in the unit during the 1995 nesting season. If true, the high concern for the one nesting pair of eagles in the Unit may no longer be argued.

RECOMMENDATIONS FOR RAPTOR MANAGEMENT IN THE CAVE GULCH AREA

In view of the information presented above, and in view of the fact that there has been no documented golden eagle or ferruginous hawk production in recent years in the Cave Gulch Area, I recommend the following:

1. Permit unrestricted natural gas drilling and production in the Cave Gulch Area.

2. Require a raptor nesting and prey monitoring program to be conducted for the next three years, to be financed by Barrett Resources Corp., and with the provision that the resource area manager can extend the monitoring program for three additional years if deemed necessary. Nesting surveys would be conducted both within the Unit and on any artificial nesting structures installed outside the Unit. Monitoring would require only about one week each month during March, April, May, and June. This monitoring would permit the area biologist to make early decisions each year on how to handle any active nests that might be started in close proximity to planned drilling operations.

3. Discourage nesting by either ferruginous hawks or golden eagles at specific nests in early spring if drilling is planned for the period between March and July but has not been started by February 15. If the biologist conducting the annual surveys and monitoring sees birds on a nest near a planned drill site, the nest should be covered with a wire mesh until the well is in the production phase.

4. Install a few artificial nesting structures in areas of least expected disturbance within the Cave Gulch Area and in the best locations as determined by the area biologist. These alternate nesting locations may replace those lost to active drilling operations.

5. Mitigate for loss of raptor nesting in the Cave Gulch Area by installing 30 nesting structures on surrounding public lands where suitable nesting substrates for golden eagles and ferruginous hawks are not available. In practical terms, structures could be installed anywhere in the resource area or district in order to maintain the species populations in the general area as discussed previously. Placement of structures would be coodinated with other existing or proposed public land uses at the preferred locations. An agreement would need to be prepared between Barrett and the BLM to agree to off-site mitigation since mitigation cannot be made on-site in this situation if unrestricted drilling is to be permitted.

ARTIFICIAL NEST STRUCTURES (ANS)

Artificial nest structures (ANS) have proved to be a successful management technique in several states and Canadian provinces (Call 1989, 1994, 1995; Olendorff 1993; Schmutz 1985, 1987; Stalmaster et al. 1982, 1985; Stalmaster 1988; Tigner 1989; Tigner and Call 1993). Properly constructed ANS protect the nestlings from terrestrial predators, provide a long-lasting nesting substrate, and provide nesting opportunities in areas where there are no natural suitable nesting sites.

The success of ANS in various areas is summarized by Olendorff (p. 36, 1993). In my experience, ANS are readily accepted by ferruginous hawks and are also occasionally used by golden eagles. The two species have *alternately* used some structures. In one area of the Rawlins BLM District, 224 FH young were produced over eight years on 31 artificial structures. This was probably from 80 to 100 *more* young than would have been produced from natural nesting substrates because of high nest mortality from terrestrial predators. Golden eagles nested on four structures in one year. While ferruginous hawks accept and nest on the structures in almost any setting within their normal preferred habitat (deserts and prairies), golden eagles seem to nest on the structures mainly in areas where there are no other suitable nesting substrates. The prey base within the normal hunting range from the established nest site for both these species is probably the most important criterion. The second most important factor is the amount and frequency of human disturbance. Both species will also use the structures, even though natural nesting substrates are available. Ferruginous hawks, which often nest directly on the ground because no other nest substrates are available, seem to like to get their nests up off the ground when an elevated nesting site becomes available.

I believe that ANS, placed in outlying areas, are a viable alternative in this situation. When gas drilling in this area has been completed and the primary human disturbance is from periodic checks of pumping equipment, tanks, etc., some raptor pairs will likely return and utilize the natural nest substrates. I recognize this is a long-term view and that no biologist likes to consider losing any raptor production in the short-term, but this area apparently has unusually high natural gas production potential and the lease owners should be provided an opportunity for reasonable development. Both golden eagles and ferruginous hawks occasionally nest on the catwalks between storage tanks, so the facilities themselves are apparently not that great a deterrent to nesting (B. Tigner, BLM, Rawlins District, pers. commun.). Also, see Plate IV.

ARTIFICIAL NEST STRUCTURE (ANS) DESIGN & CONSTRUCTION

DESIGN

Many different designs for ANS have been tried by investigators over the years (Olendorff 1993). Based on the success we have had with our design, we recommend the following (Call 1989; Tigner 1989):

FERRUGINOUS HAWK

I. Figure 8a shows the design we recommend for ferruginous hawks and Plate 1 illustrates some of the details of construction.

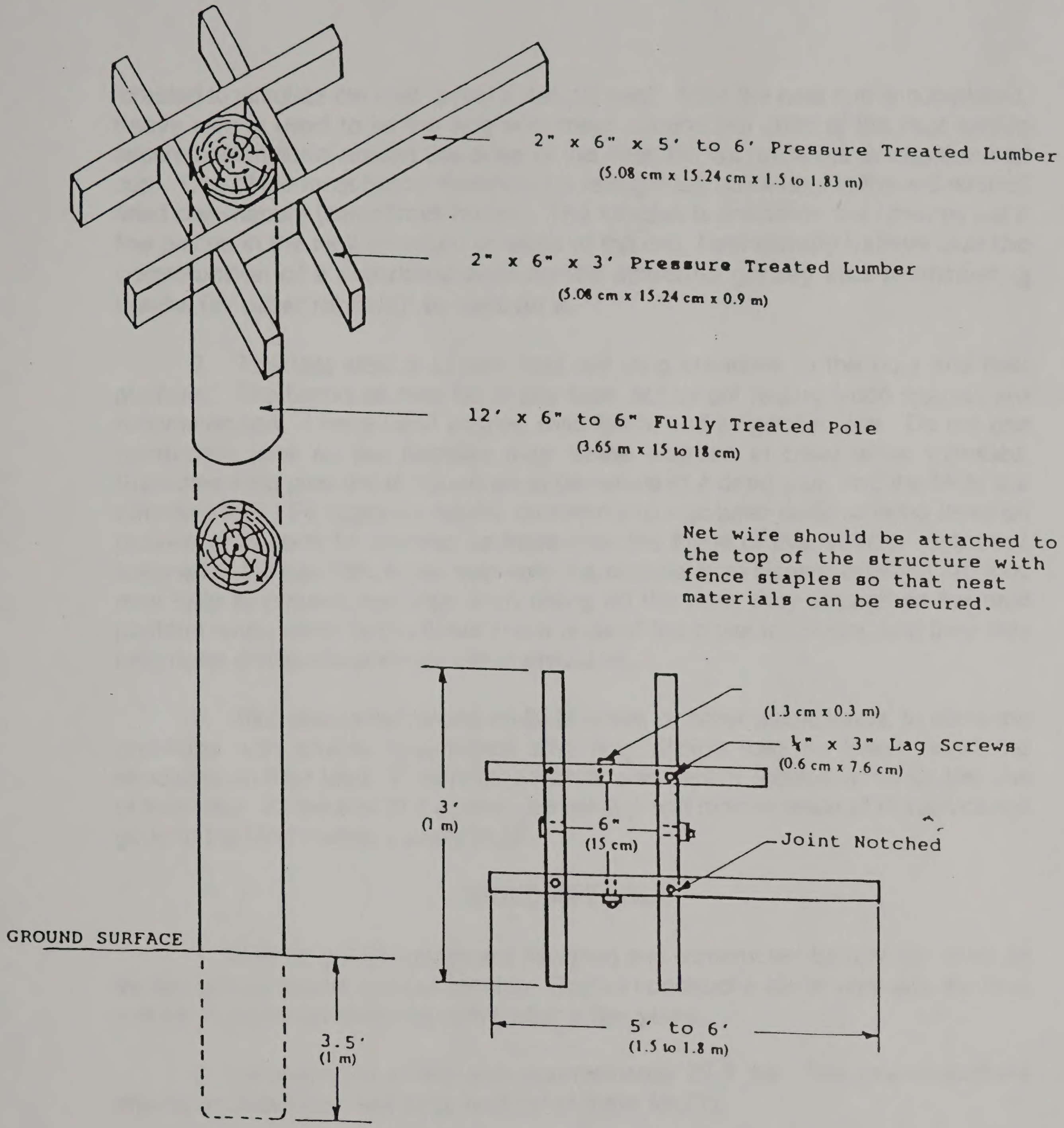
2. Twelve- foot treated poles should be used; treated lumber for the platform cross-members is recommenced, if available.

3. The nest platform structure can be pre-fabricated in the shop before going into the field for installation. Poles should be obtained prior to platform construction, and each of the platforms is individually fitted to a specific pole during platform construction. The top end of the poles (when installed) will vary in diameter, so each platform should be fitted tightly to each individual pole, so that when bolted together there will be a tight fit. Platforms and poles are numbered so the mated pairs can be easily identified in the field during completion and erection. A 1/2-inch hole is drilled near the end of each cross member for use in wiring branches to the completed structure.

4. In the field, a piece of hog wire, approximately six or seven feet long is stapled to the cross members. It should be long enough to wrap around the ends of the simulated nest which the builder constructs on the platform after erection of the pole (or in the case of GE structures, probably before erection).

5. The platform is then bolted in two directions to the correspondingly-numbered pole. Holes were drilled through both the platform structure and the pole at the time the structure was fitted to the pole. The pole and structure are then placed in a hole, approximately 3 ½ feet deep, and tamped solidly. Rocks should be tamped into the hole as the pole is set to help hold it tight.

6. Using a ladder or scaffold on a truck, a simulated ferruginous hawk nest is then constructed on the nest platform. The base of the nest is first constructed with large sagebrush (or other) branches and then smaller dry sagebrush branches are used to finish the nest. A nest cup of dried grasses, shredded bark, etc. is


2" x 6" x 5' to 6' Pressure Treated Lumber
(5.08 cm x 15.24 cm x 1.5 to 1.83 m)
2" x 6" x 3' Pressure Treated Lumber
(5.08 cm x 15.24 cm x 0.9 m)
12' x 6" to 6" Fully Treated Pole
(3.65 m x 15 to 18 cm)
(1.3 cm x 0.3 m)
¼" x 3" Lag Screws
(0.6 cm x 7.6 cm)
3'
(1 m)
6"
(15 cm)
Joint Notched
GROUND SURFACE
3.5'
(1 m)
5' to 6'
(1.5 to 1.8 m)

Net wire should be attached to the top of the structure with fence staples so that nest materials can be secured.

NOTE: Juniper or lodgepole pine branches should be attached by nails starting at least 2' (0.6 m) above ground. No ponderosa pine should be used on the side of the structure.

Figure 8a. Ferruginous hawk artifical nesting structure.

created to simulate the nest cup of a natural nest. After the nest cup is completed, heavy wire is used to tie the hog wire mesh around the ends of the nest and to secure nest material around the sides of the nest. Do not run wires across the nest cup. One of the most typical features of a ferruginous hawk nest is the inclusion of dried cow manure (sometimes horse). The function is unknown, but I always put a few pieces in the nest structure or sides of the cup. **I personally believe that the construction of a simulated nest on the structure greatly aids in attracting hawks (or other raptors) to nest on it.**

7. The last step is to wire and nail long branches to the pole and nest platform. The branches may be of any type, but longer lasting wood species are recommended. I have used juniper, river birch, and lodgepole pine. Do not use ponderosa pine as the needles may cause abortion in cows when ingested. Branches help give the structure an appearance of a dead tree, and the birds are attracted to it. Ferruginous hawks commonly use isolated dead or living trees on prairies or deserts for nesting, or trees near the fringe of tree stands. Branches fastened to the nest structures help keep the material from blowing or falling off; they may help to prevent nestlings from falling off the nest; they strengthen the nest platform when wired to the holes in the ends of the cross members; and they may help deter diving attacks from aerial predators.

8. ANS should be placed on BLM lands, or other public lands, to eliminate problems with private landowners who may decide they no longer want the structures on their land. Private landowners also usually request a fee for this use of their land. At the end of a project, ownership and maintenance of the structures goes to the land owner, usually BLM.

GOLDEN EAGLE

1. ANS for golden eagles are designed and constructed basicly the same as for ferruginous hawks, except for size. Eagles construct a larger nest and the nest material weighs considerably more after a few years.

2. I recommend a nest pole approximately 20 ft. tall. The cross members should be about four feet long, instead of three for FH.

3. The support pole may be either of wood or of metal. The platform may also be of either wood (2"x 6") or metal. In either case, the platform should be supported by braces.

PLATE I. DETAILS OF ARTIFICIAL NEST CONSTRUCTION FOR FERRUGINOUS HAWKS.

Fig. 1. The nest frame is being bolted to a 12-foot treated pole. Note the holes in ends of cross members for wiring branches to the frame.

Fig. 2. A mesh wire (hog wire) is nailed with staples to the cross members to help support the nest. One member is six feet long to serve as a perch for the hawks.

Fig. 3. The pole has been set three feet into the ground and solidly tamped. Note that the mesh wire extends beyond the cross members so that it can be bent up around the nest material to help hold It securely in place.

Fig. 4. A wildlife consultant, Dr. Mayo W. Call, is constructing a biologist's version of a ferruginous hawk nest. A truck scaffold was built to facilitate this work. An assistant hands the material up to the nest builder from the bed of the truck.

PLATE I

Fig. 1

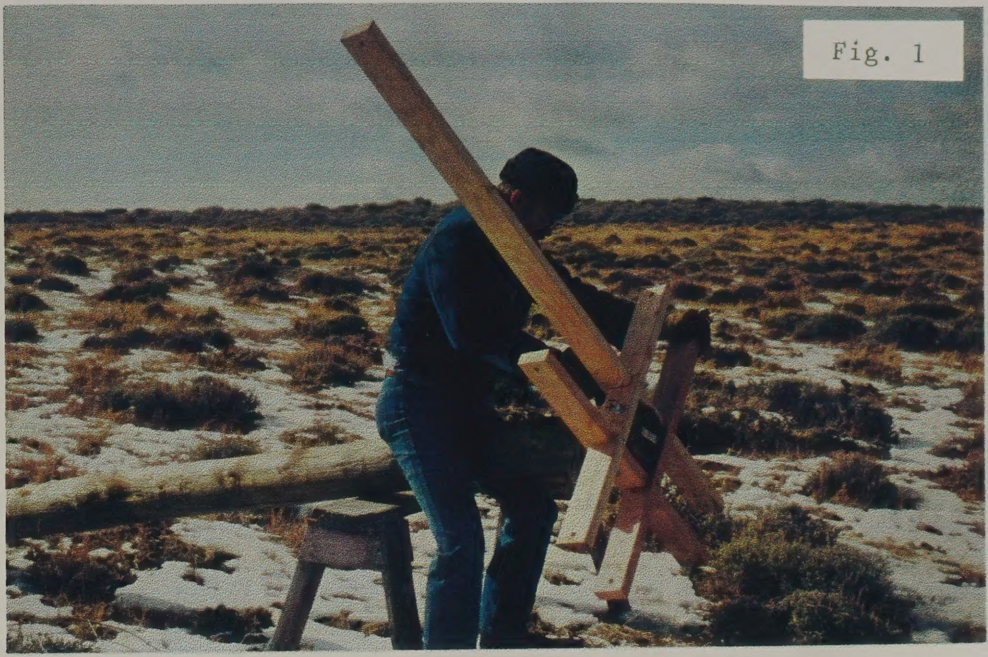


Fig. 3

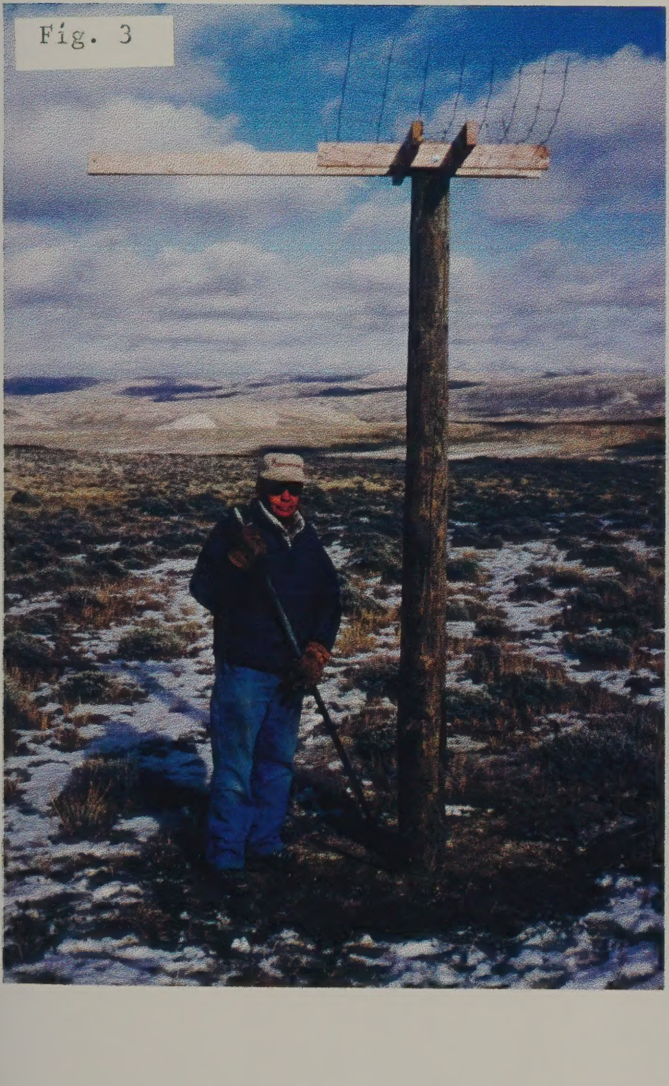


Fig. 2

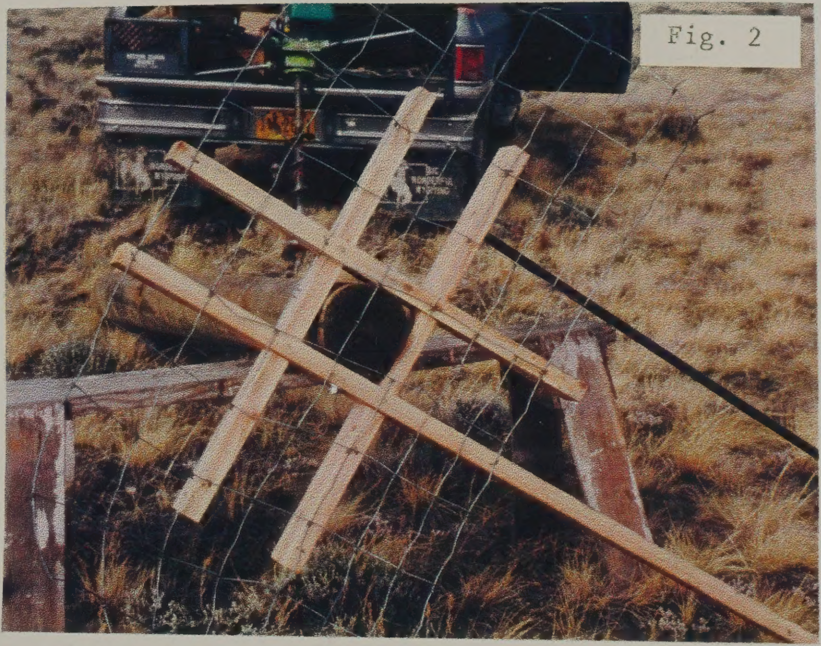
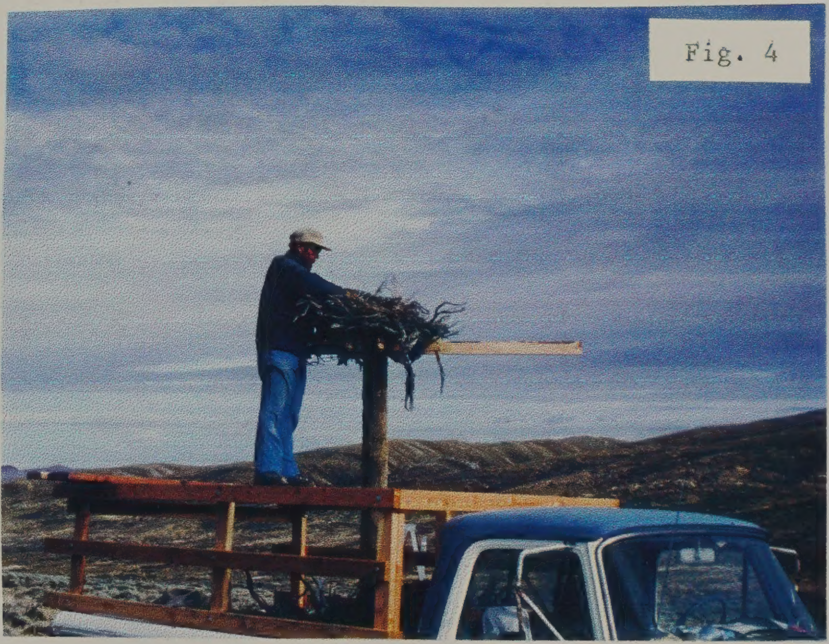


Fig. 4



4. The platform design should be such that plywood or other material may be fastened to two edges of the structure. The structure should be oriented so that shade from the afternoon sun will be provided the nestlings on hot summer days.

5. A simulated nest should also be constructed on GE artificial nest structures, much the same as for ferruginous hawks.

Plates II and III show artificial nest structures that have been used by ferruginous hawks and golden eagles. The eagles used structures intended for hawks.

Plate IV shows golden eagle and ferruginous hawk nests constructed on storage tanks or on catwalks between tanks, indicating that some birds do tolerate this kind of intrusion into their habitat, and even utilize the man-made structures for their own benefit. Even though such structures may be used by raptors for nesting, it is always advisable to move the nests onto artificial nest structures several hundred yards from the tanks in order to reduce the chance for abandonment because of the necessary visits to the facilities.

PLATE II. EXAMPLES OF ARTIFICIAL NESTS AND STRUCTURES AND THEIR USE BY FERRUGINOUS HAWKS.

Fig. 1. An artificial nest structure that was nested on by ferruginous hawks the first year available and for the next three consecutive years.

Fig. 2. This photo shows an example of a simulated ferruginous hawk nest immediately after completion and before securing branches to the sides of the structure.

Fig. 3. An artificial nest structure containing three large ferruginous hawk young. Note the branches around the sides of the nest.

Fig. 4. An adult ferruginous hawk landing on its nest which contained a single small nestling.

PLATE II

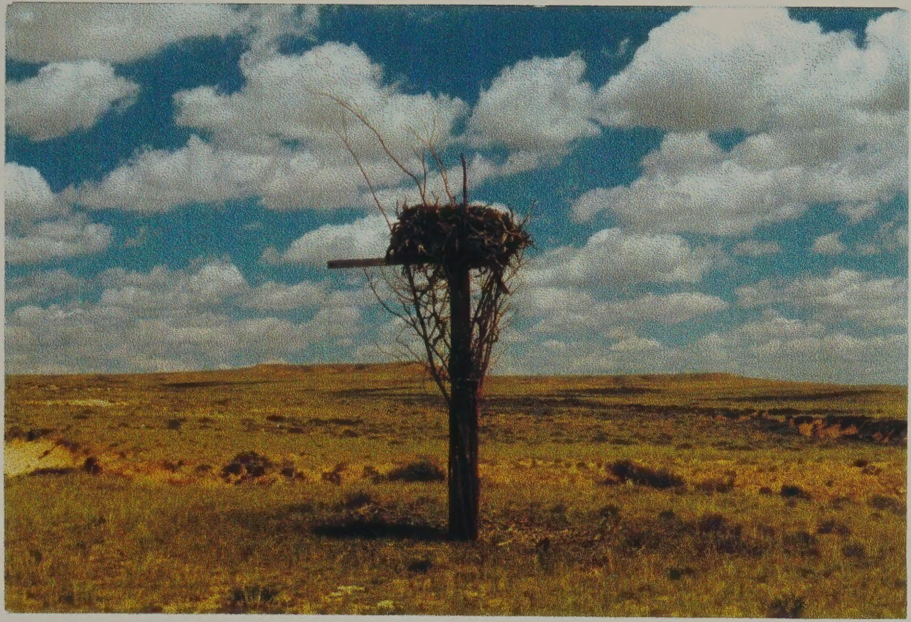


Fig. 1

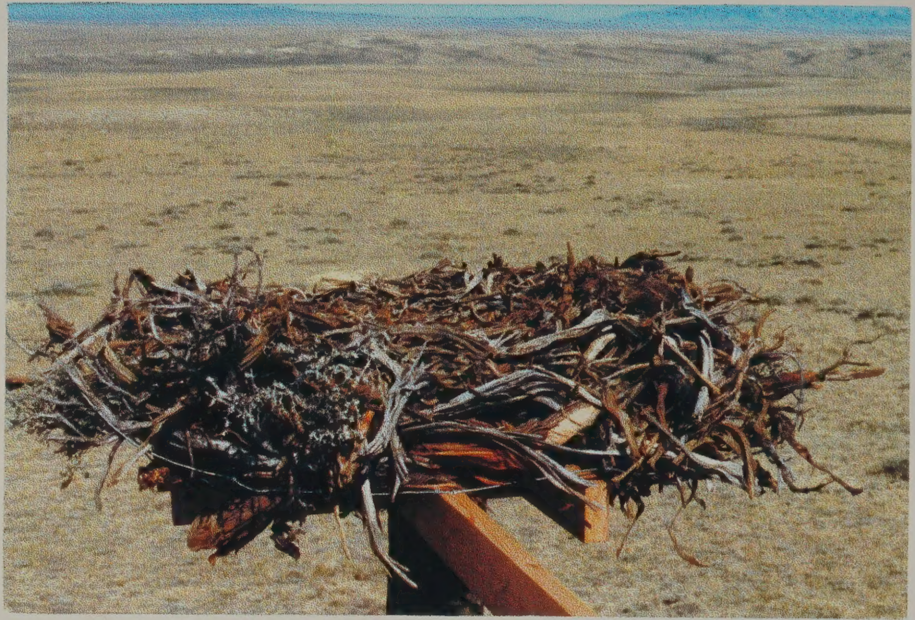


Fig. 2

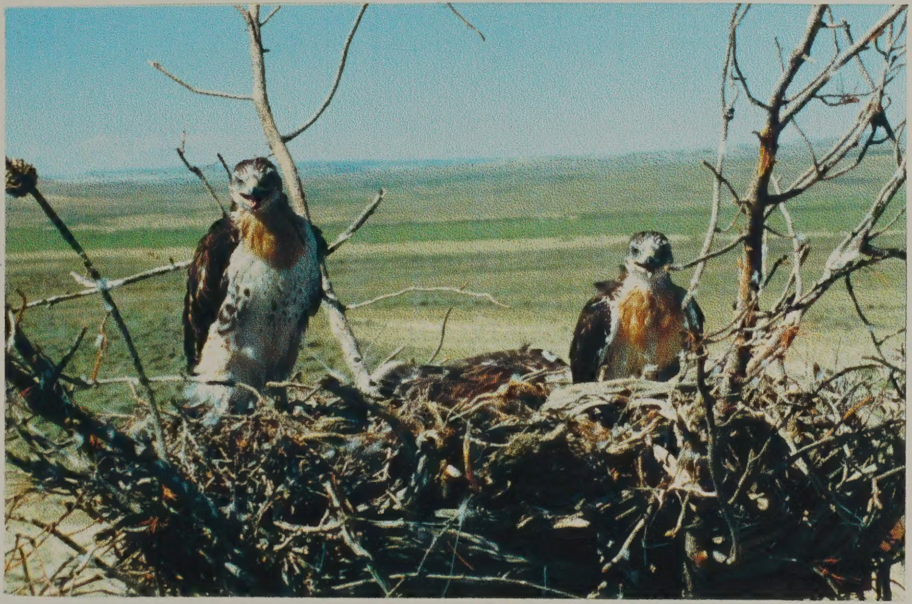


Fig. 3

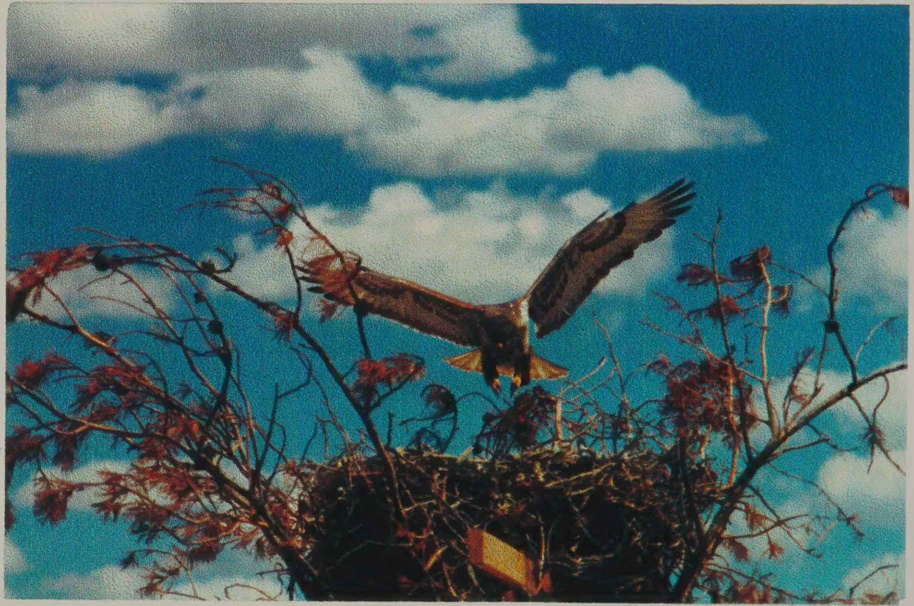


Fig. 4

PLATE III. FERRUGINOUS HAWK NESTS ON NATURAL SUBSTRATES, SHOWING SECURE AND INSECURE NESTS, AND GOLDEN EAGLE NESTS ON TWO ARTIFICIAL NEST STRUCTURES.

Fig. 1. A ferruginous hawk nest on a tall rock pinnacle that should be secure from any terrestrial predators.

Fig. 2. A ferruginous hawk nest on the ground in southern Wyoming. In many years, a high percentage of ground nests and their contents are destroyed by terrestrial predators. Much higher hawk production occurs when the birds nest on artificial nest structures.

Fig. 3. An adult golden eagle leaving a nest containing an eaglet. Several of the artificial nest structures in southern Wyoming have been used by eagles in recent years. Note the absence of cliffs or other natural substrates that could be used for nesting.

Fig. 4. An eaglet on a structure intended for ferruginous hawks.

PLATE III

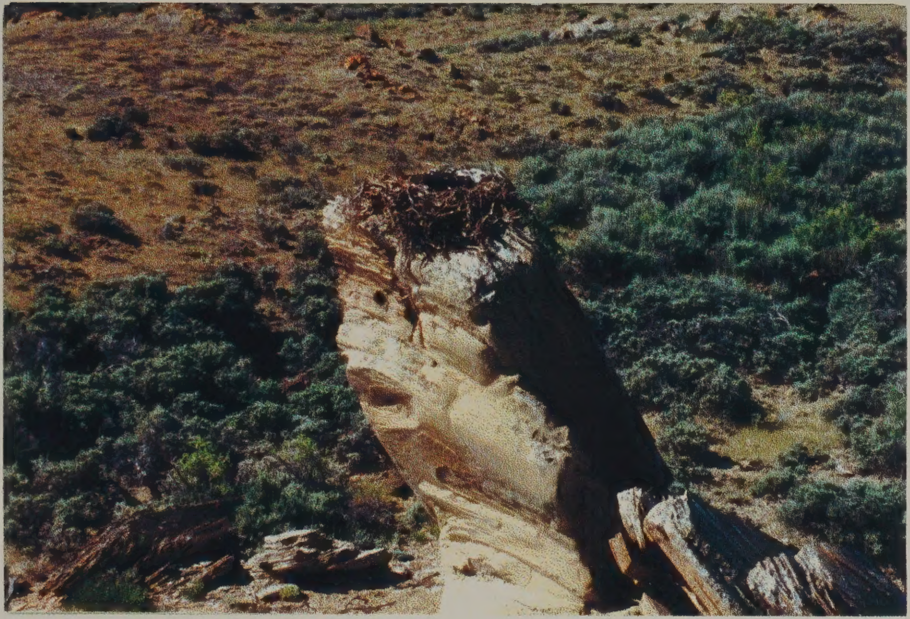


Fig. 1

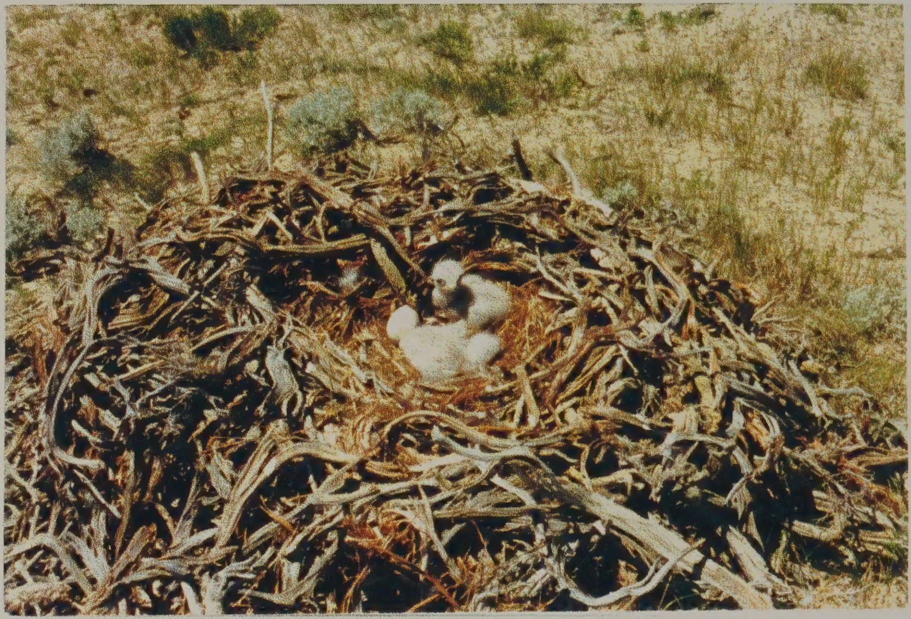


Fig. 2

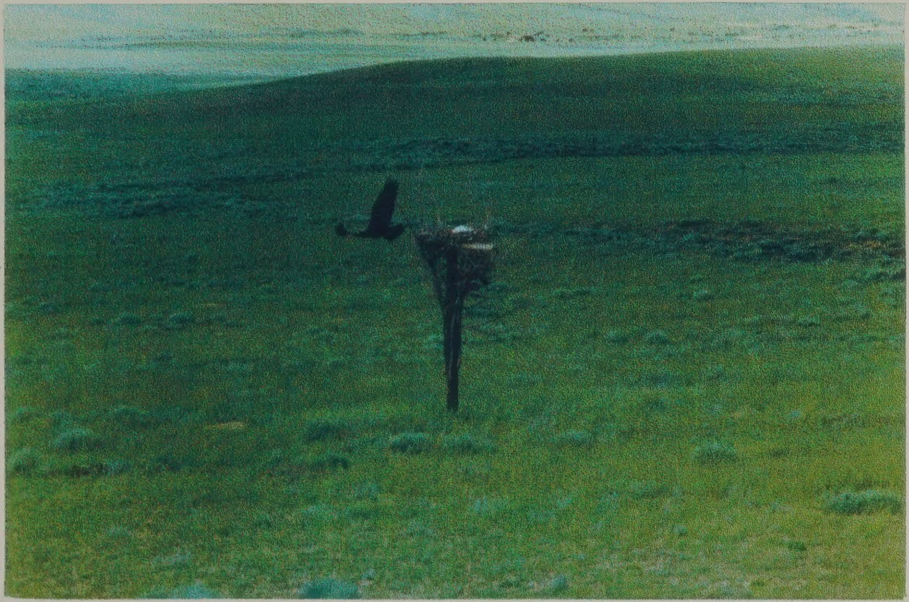


Fig. 3

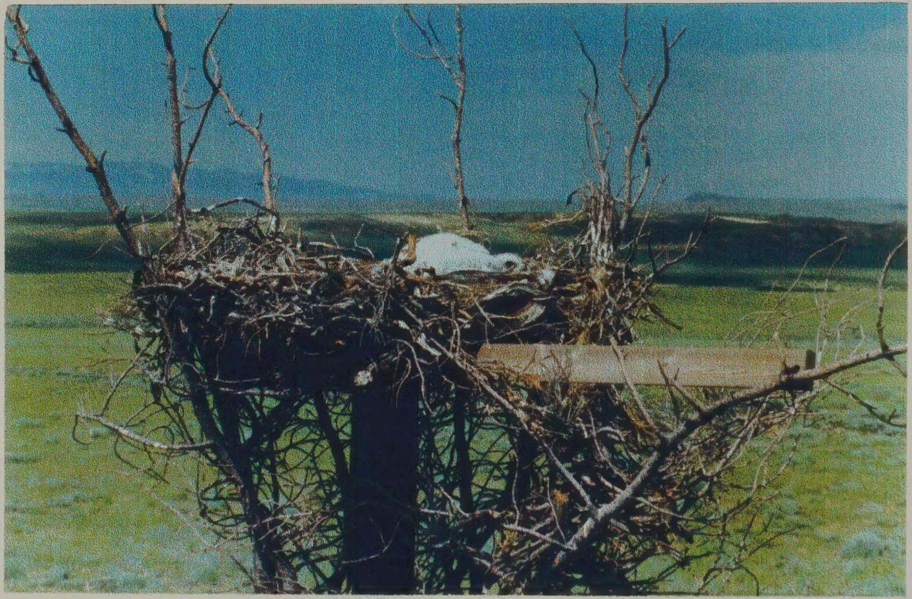


Fig. 4

PLATE IV. FERRUGINOUS HAWK AND GOLDEN EAGLE NESTS ON STORAGE TANKS IN THE RAWLINS BLM DISTRICT.

PLATE IV. FERRUGINOUS HAWK AND GOLDEN EAGLE NESTS ON STORAGE TANKS IN THE RAWLINS BLM DISTRICT.

Fig. 1. A photo of a ferruginous hawk nest built on top a storage tank. An arrow shows nest Location.

Fig. 2. Close-up of ferruginous hawk nest shown in Fig. 1.

Fig. 3. A photo of a golden eagle nest constructed on the catwalk between two storage tanks.

Fig. 4. Close-up of eaglet on nest built on catwalk between two storage tanks. These nests indicate both the hawks' and the eagles' instincts to nest on any elevated structures, even man-made structures, in desert areas where no good natural nest sites are available.

PLATE IV

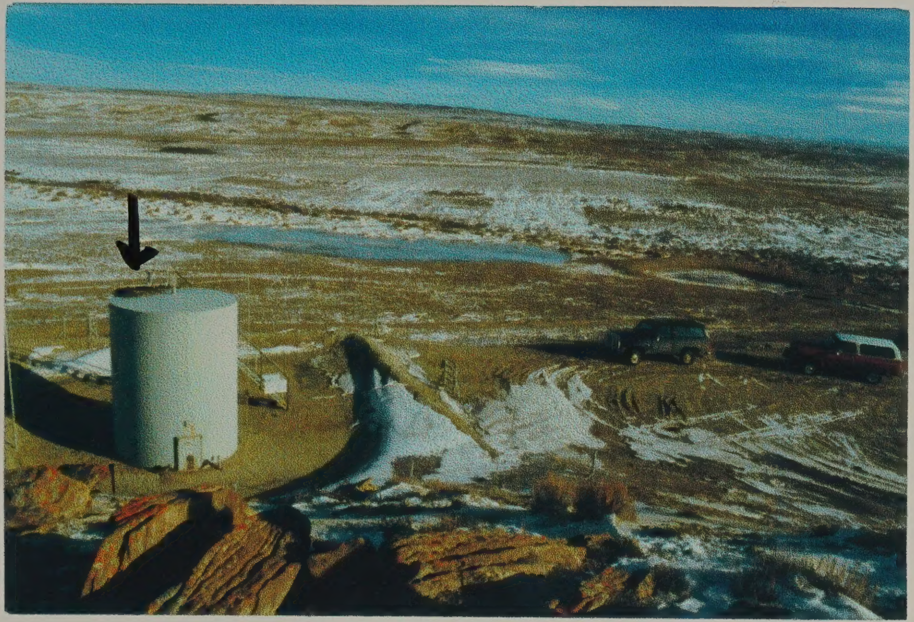


Fig. 1

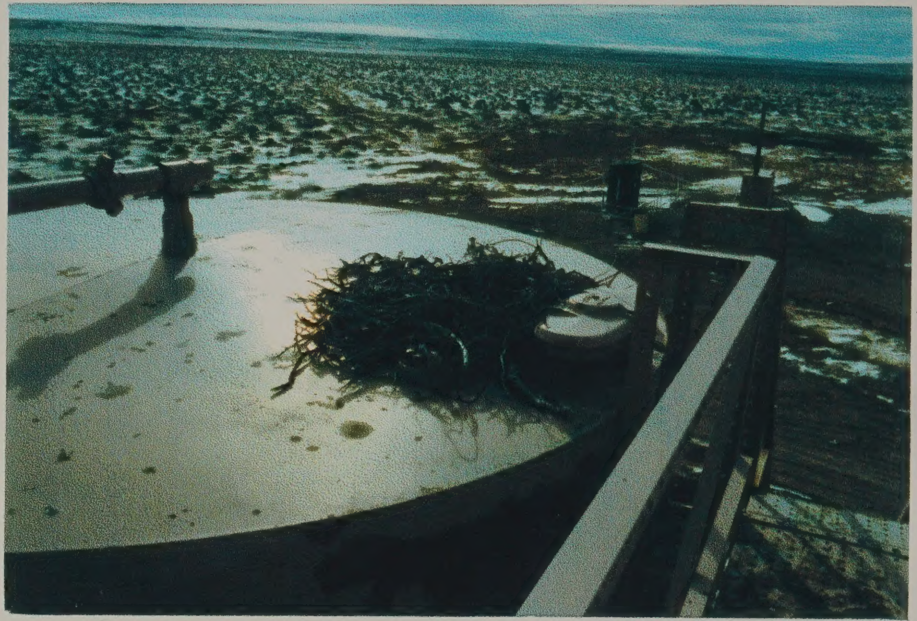


Fig. 2

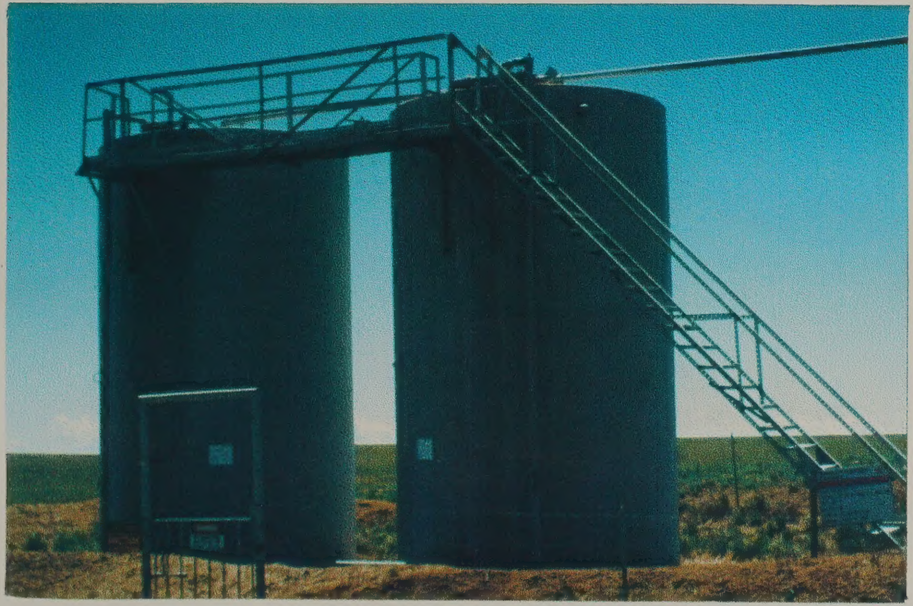


Fig. 3

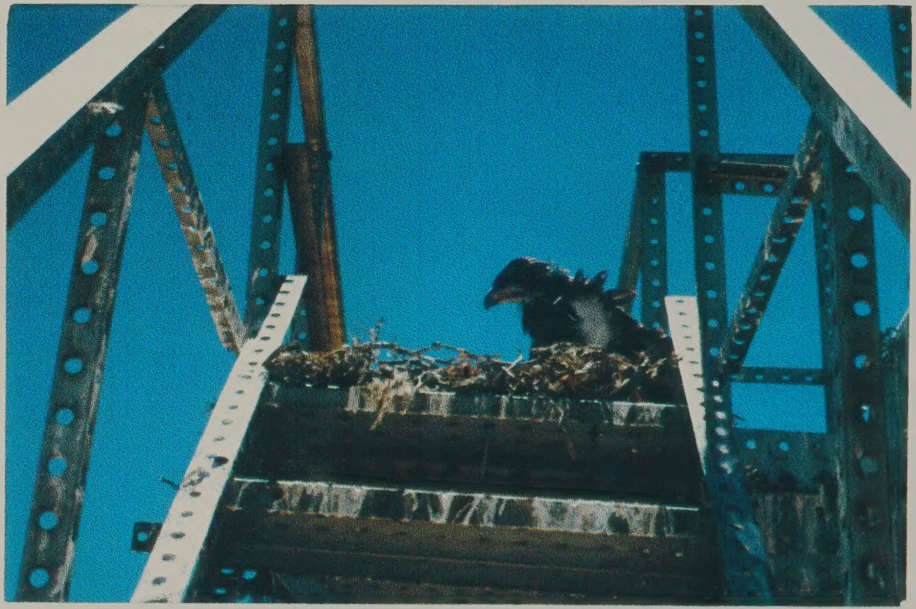


Fig. 4

PLATE V. PHOTOS SHOWING THE PRIMARY PREY SPECIES OF THE FERRUGINOUS HAWK AND THE GOLDEN EAGLE.

PLATE V. PHOTOS SHOWING THE PRIMARY PREY SPECIES OF THE FERRUGINOUS HAWK (Upper middle photo) **AND THE GOLDEN EAGLE** (Lower Middle Photo), **I.E., THE WYOMING GROUND SQUIRREL, WHITE-TAILED PRAIRIE DOG, DESERT COTTONTAIL, AND WHITE-TAILED JACKRABBIT.**

Upper left photo: Wyoming ground squirrel.

Lower left photo: White-tailed prairie dog.

Upper right photo: Desert cottontail.

Lower right photo: White-tailed jackrabbit.

PLATE V

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